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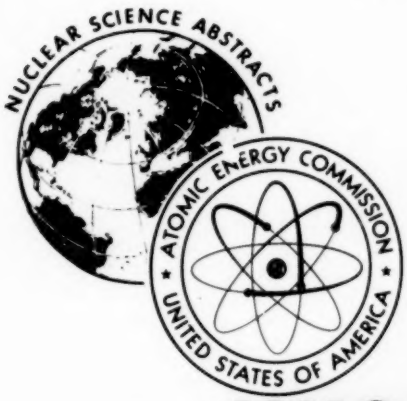

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Volume 19, Number 22, November 30, 1965

NUCLEAR SCIENCE ABSTRACTS

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Volume 19, Number 22 November 30, 1965

NUCLEAR SCIENCE ABSTRACTS

BIOLOGY AND MEDICINE

General

42229 (AEET/HP/Th-21) PHYSIOLOGICAL NORMS IN INDIAN ADULTS—DATA ON TOTAL BODY WEIGHT AND WEIGHTS OF TWELVE BODY ORGANS. Venkataraman, K.; Raghunath, V. M.; Santhanam, K.; Somasundaram, S. (Atomic Energy Establishment, Trombay (India). Health Physics Div.). 1964. 65p. Dep. mn.

Data are presented on the physiological norms in Indian adults, including total-body weight and the weights of 12 individual body organs. The norms were determined from over 13,000 post-mortem records of accidental and instantaneous death. The data will be used to formulate standards for use in studies of internal radiation levels. (C.H.)

42230 (COO-1256-2) CONTROL OF THE BIOSYNTHESIS OF ALKALINE PHOSPHATASE IN ESCHERICHIA COLI K-12. Finnerty, W. R. (Indiana Univ., Indianapolis. Medical Center); Novelli, G. David. (Oak Ridge National Lab., Tenn.). [1964]. Contract AT(11-1)-1256. 19p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Investigations concerned with the biosynthesis of alkaline phosphatase in a cell free system derived from Escherichia coli K-12 are discussed. Cells in the log phase of growth were separated by centrifugation, and alkaline phosphatase activity was assayed. One unit of alkaline phosphatase activity was defined as the amount of enzyme required to hydrolyze 0.34 millimicromole of paranitro-phenyl phosphate per min at 37°C. Readings were made in a Klett-Summerson colorimeter at 420mu, and converted to optical density. Enzyme activity was calculated by the formula: units/ml/min = (O.D. × 1000/5) × dilution factor × sample volume to unity/reaction time in min. The increase in enzyme activity was expressed as the difference between the activity of enzyme measured after a specific time period and the activity measured in the same flask at zero time. Incorporation of uniformly ^{14}C-labeled L-leucine, protein concentrations, and DNA and DNA polymerase were also measured. Alkaline phosphatase activities were observed to increase when a derepressed supernatant fraction was incubated with a derepressed particulate fraction in the presence of requisite supplements. Enzyme activities were found to increase between two and five fold depending on the preparation. Data showed significant stimulation of apparent alkaline phosphatase synthesis by derepressed DNA, s-RNA, RNA polymerase, and RNA polymerase plus s-DNA. Nucleic acids isolated from unrelated cell sources demonstrated no significant increases in alkaline phosphatase activities, but rather an inhibition of activity. When wild type E. coli K-12, alkaline (phosphatase positive), was crossed with preparations from a mutant, E. coli K-12 (alkaline phosphatase negative), no specificity to ribosomes with respect to alkaline phosphatase synthesis was found, but an obligate specificity for derepressed supernatant preparations was implicated. Further experiments showed that the apparent enzyme increases are the result of de novo synthesis of alkaline phosphatase from constituent amino acids mediated by gene-specific DNA and RNA polymerase. (H.G.D.)

42231 (NASA-SP-7011(11)) AEROSPACE MEDICINE AND BIOLOGY. A Continuing Bibliography. (National Aeronautics and Space Administration, Washington, D. C. Scientific and Technical Information Div.). May 1965. 175p. CFSTI $1.00 cy, $1.00 mn.

A continuing bibliography which, by means of periodic supplements, serves as a current abstracting and announcement medium for references on aerospace biology and medicine. The publication is compiled through the cooperative efforts of the Aerospace Medicine and Biology Bibliography Project of the Library of Congress (LC), the American Institute of Aeronautics and Astronautics (AIAA), and NASA. It assembles, within the covers of a single bibliographic announcement, groups of references that were formerly announced in separate journals, and provides a convenient compilation for medical and biological scientists. Additional background details for this publication can be found in the first issue, NASA SP-7011, which was published in July 1964. Supplements are identified by the same number followed by two additional digits in parentheses. In its subject coverage, Aerospace Medicine and Biology concentrates on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. In general, emphasis will be placed on applied research, but references to fundamental studies and theoretical principles related to experimental development also qualify for inclusion. The contents of this issue are comprised of abstracts that were prepared by the three contributing organizations. Approximately 600 abstracted references are included, the majority of which were originated by NASA or the Library of Congress. (H.G.D.)

42232 (ANL-Trans-209) SPACE PHYSIOLOGY. SOME RESULTS AND OUTLOOKS OF EXPERIMENTAL INVESTIGATIONS. Gazenko, O. G.; Parin, V. V.; Chernigovskii, V. N.; Yazdovskii, V. I. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Preprint p.1-16 of the report presented at the plenary session of the 10th Meeting of the All-Union I. P. Pavlov Physiological Society at Yerevan, October 22-28, 1964, Moscow. 17p. Dep. mn; CFSTI, $1.00 cy, $0.50 mn; JCL, $1.60 fs, $0.80 mf.

Data are summarized from physiological studies on 6 USSR astronauts who participated in space flights varying from one orbit of the earth to 119 hr in orbit between 1961 and 1963. The studies were made before, during, and for prolonged periods after space flight. Data are included on the effects of functional stress induced by transverse accelerations, defense responses, muscular stress, weight-

lessness, and the effects of conditions encountered during prolonged space flight on respiration, cardiovascular systems, working ability, psychological functions, and other parameters. Data from electroencephalograms, cardiograms, and electrooculograms are presented that supplement other observations on adaptation processes of humans during the conditions of space flight of a duration of approximately 2 days. (C. H.)

42233 MAJOR PITFALL IN THE USE OF THE SAME RADIOISOTOPE FOR THE REPETITION OF ERYTHROCYTE AND OTHER SURVIVAL STUDIES. Lorber, Mortimer (Georgetown Univ. Schools of Medicine and Dentistry, Washington, D. C.). Acta Haematol., 33: 237-45 (1965).

Two modified calculation procedures are described for serial determination of life span in erythrocytes. The first method (Method I) is employed when the rate of destruction of the initially labeled cells is believed to continue unchanged during the repeat study. On semilogarithmic graph paper the point on the ordinate representing the isotope content of the zero blood sample of the repeat study is connected with its half value on the day corresponding to the half-time of disappearance ascertained in the initial procedure. For each sample obtained during the repeat procedure, the corresponding value of the ever-diminishing zero blood isotope content for that day is read directly from that graph and subtracted from the total isotope content corrected for 50% hematocrit. In Method II, the total counts present in each sample of the repeat study are corrected to 50% hematocrit without subtracting the zero isotope level. The total counts are plotted on semilogarithmic graph paper. The resulting slope, although based on numerically inaccurate values for each individual population, reflects the mean life span of all tagged cells in the circulation as well as would attempts to differentiate the two components; by definition both have the same survival when this method is employed. To estimate each population, as when red cell volumes are determined, after using method II, the appropriate values should be diminished as in method I. Method II should be employed if following an initial determination of life span there is exposure to a variety of hemolytic agents or diseases or the development of blood loss. These factors would alter the survival of the originally tagged cells to that of those administered for the follow-up study. These methods have the advantage of being simple to perform as they involve semilogarithmic graphic plotting rather than complex mathematical analysis. However, if the pattern of cell destruction cannot be anticipated, different labels must be used for each study. (TCO)

42234 RATE OF MUTATION TO PHAGE RESISTANCE IN $^{3}H_{2}O$ MEDIUM. Pollard, Ernest; Lemke, Martha (Pennsylvania State Univ., University Park). Mutation Res., 2: 213-17(June 1965).

The rate of mutation of Escherichia coli B to T1 and T2 phage resistance in $^{3}H_{2}O$ medium was compared to the mutation rate in $H_{2}O$ medium to determine whether the tunneling of a proton from one base to another can account for mutations. The results suggest that proton tunneling, if it causes mutants, is rare when compared with other mechanisms which are responsible for forming mutants. (auth)

42235 ISOTOPE EFFECT IN TUNNELING AND ITS INFLUENCE ON MUTATION RATES. Loewdin, Per-Olov (Univ. of Florida, Gainesville and Univ. of Uppsala). Mutation Res., 2: 218-21(June 1965).

The possible importance of the phenomenon of proton tunneling in evaluating the influence of proton mass on mutation rates is discussed. Tunneling times were derived for protons and deuterons. The time is denoted as the relaxation time of the double-well and is mass-dependent to the same extent as the single tunneling time. However, particle distribution was essentially independent of the transmission coefficient and of the particle mass. Recent calculations on the G-C base pair indicate that the relaxation times for protons as well as deuterons are very short in comparison to the replication time of DNA. Because of the tunnel effect, the system has sufficient time to reach thermal equilibrium over the double-well, and in treating the Boltzmann distribution, there is finally a very small isotope shift, depending on a slight difference in energy levels for the proton and deuteron. (H.G.D.)

42236 RADIOISOTOPE APPLICATION IN VETERINARY MEDICINE. Gligorijevic, Jovan. Nukl. Energija, No. 2, 16-22(Apr. 1965). (In Slovenian).

The history of radioisotope applications to veterinary medicine in Yugoslavia is reviewed. Tracers are being used in studies of biochemical physiological and pathophysiological processes, in investigations of etiopathogenesis and enhancement of the diagnosis of disease, and in the improvement of animal health protection. Radioisotopes are used as sources of radiation in radiation protection studies. The effects of radiation on the antigenic properties of causative factors (viruses, bacteria, and parasites) are also being studied. The degree of biological radioactive contamination of farm animals and food of animal origin by fission products is being established. Uses of radiation for food sterilization and preservation are being investigated. (M.C.G.)

42237 CYTOLYTIC ANTIBODY-ELECTRONIC COUNTING ANALYSIS OF NORMAL AND CHIMERIC TISSUES. Uyeki, E. M. (Battelle-Northwest, Richland, Wash.). Transplantation, 3: 610-17(Sept. 1965). (HW-SA-3997).

Tryptic digestion-electronic particle counting analysis of cytolytic antibody was made on isolated cells from lymph node, spleen, peritoneum, and bone marrow. Results obtained were comparable with those using the dye-exclusion technique. Usefulness of this technique in donor-host cell analysis of chimeric tissues has been demonstrated by its application to synthetic donor-host cell mixtures and no tissues from radiation chimeras. (auth)

Ecology

42238 (ORNL-3721(Suppl. 1)) CONCENTRATIONS, TOTAL STREAM LOADS, AND MASS TRANSPORT OF RADIONUCLIDES IN THE CLINCH AND TENNESSEE RIVERS, Supplement No. 1 to Status Report No. 5 on Clinch River Study. Churchill, M. A.; Cragwall, J. S. Jr.; Andrew, R. W.; Jones, S. Leary (Oak Ridge National Lab., Tenn.). Aug. 1965. Contract W-7405-eng-26. 76p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Progress is reported on collection and interpretation of information on radionuclides suspended or dissolved in the waters of the Clinch River downstream from Oak Ridge, Tennessee. Daily samples were taken at six stations between November 1960 and November 1962 and at one station from January 1962 to November 1962. Determinations were made of concentrations and total loads of ^{90}Sr, ^{137}Cs, ^{60}Co, and ^{106}Ru. Weekly average concentrations in pC/liter are reported for the seven stations. At only one station did the flow-weighted mean concentrations of ^{90}Sr and ^{106}Ru exceed MPC values for drinking water. Because of extreme difficulty in analyzing the gamma spectrum to identify the activity due strictly to ^{137}Cs when there is a high concentration of ^{106}Ru present, no great confidence could be placed in any of the ^{137}Cs data. Maximum concentrations of ^{60}Co found at all stations were far below MPC values. Data suggest that from 90 to 98 percent of the ^{90}Sr activity was associated with the dissolved solids, whereas the greater part of the ^{137}Cs activity was found in suspended solids. Seventy to 98 percent of the total ^{60}Co present in the water phase was actually in solution. In White Oak Creek and in the Clinch River, approximately 20 to 30 percent of the ^{60}Co present was associated with the suspended solids, but in the Tennessee River the percentage dropped to only 2 or 3 percent. This seems to indicate loss of sediment from the water phase in a downriver direction. From 79 to 94 percent of the ^{106}Ru activity was associated with the dissolved solids. Recommendations concerning the monitoring program and improvements in studies of this type are listed. (H.G.D.)

42239 UTILIZATION OF ^{60}Co FOR THE MARKING OF SERPENTS. Naulleau, Guy; Courtois, Guy (Faculte des Sciences, Nancy). Compt. Rend., 260: 6219-22(June 9, 1965). (In French).

The utilization of ^{60}Co for labeling serpents in nature was investigated. Preliminary tests showed that the serpents reacted well to the presence of a fragment of inactive metallic wire. As no data were available on the tolerance of serpents to radiation, vipers were labeled with 14 and 90 μC and 0.5 and 1 mC. The results showed that the higher doses were lethal, generally within 3 months after labeling. The 14 μC dose necessitates a very tedious surface search, but the 90 μC seems well adapted to long-range observations in the natural state. The detection is good at the surface and can be done up to a depth of 0.50 m in the ground. (J.S.R.)

Metabolism, Tissue Distribution, and Toxicology

Refer also to abstracts 42258, 42584, and 42638.

42240 (AECD/AG/5) UTILISATION OF FERTILISER PHOSPHORUS BY BARLEY PLANTS FROM AN IRANIAN CALCAREOUS SOILS USING ^{32}P LABELLED SUPERPHOSPHATE. Habibullah, A. K. M. (Atomic Energy Centre, Dacca (Pakistan)). May 1965. 7p. Dep. mn.

Five barley seedlings per pot were planted in a pot culture experiment conducted on an alluvial calcareous soil to which 40, 80, or 160 lbs $^{32}P_2O_5$/acre was applied. During the period under observation it was found that phosphorus requirement for barley plants is optimum at 4 weeks after planting, and steadily increases with the rate of application. Percentage uptake of fertilizer phosphorus increased with the increase of dose irrespective of the time of growing. Percentage uptake of fertilizer phosphorus decreased with the age of the plant. Otherwise soil phosphorus uptake was increased with time. (H.G.D.)

42241 (CEA-R-2708) ABSORPTION DU CESIUM PAR L'ORGE INFLUENCE DE SA RETENTION DANS LE SOL ACTION COMPETITIVE DU POTASSIUM. (Cesium Absorption by Barley—Influence of its Retention by the Soil—Competitive Action of Potassium). Ferron-Trosseau, Francoise (Commissariat a l'Energie Atomique, Fontenay-Aux-Roses (France). Centre d'Etudes Nucleaires). May 1965. 64p. Dep. mn.

The effects of variations in cesium concentration and presence of potassium cations on cesium uptake by barley were investigated with various culture media. Cesium distribution in the soil and between the soil and solution was considered as a function of the quantity of Cs. Significant differences were noted in responses of the barley to nutritive solutions and to soils. In the nutritive solution, the fraction of Cs (radioactive and stable) absorbed by barley remained practically constant in the presence of increasing amounts of stable cesium. Whereas in soil, the fraction of the radioactive cesium absorbed, increased in relationship with a rapidly decreasing selectivity of the soil for cesium anions. The difference between the results is thus explained by the very pronounced selectivity of the soil studied for Cs anions as long as the proportion of Cs remains low, close to that of other soils. Addition of potassium to a culture medium already rich in this element did not reduce the absorption of cesium by barley. Thus, radiocesium incorporated without carrier into a soil of medium exchange presented relatively little danger because of the close interdependence of radiocesium uptake by plants and its retention in the soil. (H.G.D.)

42242 (COO-1170-6) INHALATION EXPOSURE OF MICE TO AN AEROSOL OF GADOLINIUM OXIDE. Talbot, Richard B.; Davison, Fred C.; Reece, William O. (Iowa State Univ. of Science and Tech., Ames. Inst. for Atomic Research and Iowa State Univ. of Science and Tech., Ames. Coll. of Veterinary Medicine). May 1965. Contract AT(11-1)-1170. 23p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Exposure of mice to an aerosol of approximately 30 mg. of gadolinium oxide per cubic meter of air for periods up to 120 days revealed a progressive impaction of gadolinium in the lungs as exposure time increased. The material could be seen in the tracheobronchial lymph nodes after 100 days of exposure. No acute inflammatory reactions and no fibrosis were present. The tissue reaction was a thickening of the alveolar wall and an accumulation of dust laden macrophages. Other organs were normal, and hematological parameters of exposed mice were not significantly different than control mice values. (auth)

42243 (TID-21163) THE ROLE OF MAGNESIUM IN BIOLOGIC PROCESSES. A Review of Recent Developments. Aikawa, Jerry K. (Colorado Univ., Denver. School of Medicine). [1964]. Contract AT(11-1)-1343. 17p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Recent studies on the role of mg in biological processes, in which ^{28}Mg and the atomic absorption spectrometer were used as tools, are reviewed. Results suggest the existence of an active transport mechanism common to both Ca and Mg affecting the gastrointestinal absorption of Mg. The manifestations and causes of clinical Mg deficiency are many and varied. The metabolism of Mg in bone and mitochondria is discussed. (62 references.) (C.H.)

42244 (TID-22106) INFLUENCE OF GENOTYPE ON RATE OF STRONTIUM ABSORPTION BY BARLEY (thesis). Pinkas, Leonard Lieber Hirsch (Minnesota Univ., Minneapolis). Aug. 1965. Contract AT(11-1)-1097. 63p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Studies of rates of strontium absorption from nutrient solutions containing eight concentrations of ^{89}Sr indicate a definite trend towards higher rates of strontium absorption by roots of intact 12-day old Regal barley seedlings as opposed to roots of Tregal seedlings of similar age. Differences in rates of strontium absorption between the two varieties were also indicated by higher concentrations of strontium in fluids exuding from decapitated Regal roots as compared to fluids exuding from decapitated Tregal roots. The kinetics of Sr absorption by barley are discussed. (36 references.) (C. H.)

42245 THE EFFECT OF DIFFERING DEMANDS FOR BLOOD CELL PRODUCTION ON DNA SYNTHESIS BY HEMOPOIETIC COLONY-FORMING CELLS OF MICE. Becker, A. J.; McCulloch, E. A.; Siminovitch, L.; Till, J. E. (Univ. of Toronto; Ontario Cancer Inst., Toronto). Blood, 26: 296-308(Sept. 1965).

A technique for estimating the fraction of hemopoietic colony-forming progenitor cells in in vivo DNA synthesis was described. The technique is based on the ability of tritiated thymidine to inhibit the growth of those colony-forming cells which, by virtue of their presence in the S-phase during a 20-minute incubation in vitro, in the presence of 500 μC/ml of $^{3}HTdR$, incorporated large amounts of the nucleoside. The method was applied to transplanted colony-forming cells proliferating in spleens of heavily irradiated recipients as well as to cells from normal fetal liver, normal marrow, and normal spleen. In situations where the hemopoietic system is expanding (fetal liver and regenerating transplants), a large fraction, 40 to 65%, of the stem cells are in DNA synthesis. In the steady-state situations (adult marrow and spleen), the fraction of cells in DNA synthesis is almost imperceptible using this technique. It is concluded that control mechanisms that govern the rate of hemopoiesis operate, at least in part, by altering the generative cycle of blood-forming progenitor cells. (auth)

42246 THE INFLUENCE OF SALTS OF SOME HEAVY METALS ON OCCURRENCE OF PIGMENTARY CHANGES IN THE HAIRS OF ANIMALS FED BY POISONED MOTHERS. Mrozikiewicz, Aleksander; Widy, Wladyslaw (Medical Academy, Poznan, Poland). Bull. Soc. Amis Sci. Lettres Poznan, Ser. C, 12: 71-3(1963).

Studies were made to determine if similar pigment changes, as seen in thallium poisoning, occur in young animals nursed by their mothers poisoned with various heavy metals salts. Experiments were carried out on female rats weighing 180 to 260 g, each nursing three offspring 4 to 10 days old. The mother animals were poisoned with bismuth nitrate, uranyl acetate, mercuric chloride,

gold trichloride, and lead acetate. The quantities of these compounds, which were administered only once, were close to the lethal dose. Two were introduced orally ($Bi(NO_3)_3$ and $HgCl_2$) and three subcutaneously ($UO_2(CH_3COO)_2$, $AuCl_3$, and $Pb(CH_3COO)_2$). Four females were poisoned with each of the metal salts thus providing material from 20 females and 60 young rats for examination. The results showed pigmentary changes of different intensity in hair roots after poisoning with various heavy metals. The most pronounced changes resulted from bismuth and uranium; they resembled those obtained with thallium poisoning. After mercury, gold, and lead administration, however, only slight indistinct changes occurred and did not reach the intensity found after thallium poisoning. On the basis of the results there is reason to believe that, as the case in experimental animals, darkenings of hair roots would be found not only in the hairs of a woman poisoned with these metals, but also in those of the child nursed by her. (TCO)

42247 ACCUMULATION OF RADIOACTIVE ISOTOPES OF PHOSPHORUS, YTTRIUM, IODINE AND MERCURY BY LARVAE OF AQUATIC INSECTS. Getsova, A. B.; Volkova, G. A. (Zoological Inst., Leningrad). Federation Proc., 24: Transl. Suppl., Pt. II, T683-4(July-Aug. 1965).

Translated from Zool. Zh., 43: 1077(1964).

Larvae of 7 representative aquatic insects were placed in separate aquaria containing pond water and 10 μC/l of ^{131}I, ^{203}Hg, ^{32}P, or ^{91}Y was added to each aquarium. Samples of insects and water were analyzed for radioactivity on the 2nd, 4th, 8th, and 16th days. Data are presented on the coefficients of accumulation (CA) of each radioisotope by each insect species. The highest values of the CA for most species were given by Y and Hg, P gave a high CA in only two species, and I was characterized by low CA values in all species. (C.H.)

42248 ^{90}Sr IN THE LONG BONES OF PATIENTS WITH SARCOMA. Woodard, H. Q.; Harley, J. H. (Sloan-Kettering Inst. for Cancer Research, New York; Atomic Energy Commission, New York). Health Phys., 11: 991-8(Oct. 1965).

Between May 1962 and May 1964, determinations were made of ^{90}Sr in bones of fifty-four limbs which had been amputated because of sarcoma originating in bone or soft parts. Samples did not include tumor tissue. Radium-226 was also measured in many of the specimens. The patients ranged in age from 2 to 74 years and were in good general health. The limbs were all in use prior to amputation. None of the results indicated that unusual internal radiation was a factor in the induction of the tumors in these patients. There was no significant difference between the mean ^{90}Sr burdens of the bones obtained in the first and second years, although the latter averaged slightly higher. The mean ^{90}Sr burden declined with age from 2.5 pC/g Ca at ages 2 to 9 years to 0.36 pC/g Ca at 30 to 50 years. There was a suggestion of an increase after the age of 50 years. In the bones of patients over 20 years of age the ^{90}Sr/g Ca averaged nearly twice as high in the ends as in the shafts. In the bones of fourteen children aged 2 to 14 years, there was little difference between the ends and the shafts. If the ^{90}Sr in these growing bones had been proportional to the amounts in the diets at the times when the bones were formed, the activity in the ends would have exceeded that in the shafts by factors of 3 to 5. Since it did not, it may be concluded that the bones were being remodeled very rapidly. (auth)

42249 THE QUANTITATIVE ACCUMULATION OF $^{95}Zr + ^{95}Nb$ AND $^{140}Ba + ^{140}La$ IN CARPETS OF FOREST MOSS. A FIELD STUDY. Svensson, Goeran K.; Liden, Kurt (Univ. of Lund, Sweden). Health Phys., 11: 1033-42 (Oct. 1965).

During the 20 months from the beginning of the nuclear weapons tests in September 1961, the accumulation of fission products in carpets of forest moss vegetation was investigated. A number of moss samples as well as the precipitation were collected during the actual time period. With gamma spectrometric methods elaborate determinations of $^{95}Zr + ^{95}Nb$ and $^{140}Ba + ^{140}La$ in these samples were made. The results show that the moss content of the fission products studied is greater than the corresponding integrated activity of the precipitation. A wash-out experiment indicated that no significant loss of these nuclides occurred from the moss. Therefore, from the results of the field study it was concluded, firstly, that the actual nuclides are very efficiently absorbed in this plant and, secondly, that during a certain period of time there is a substantial dry deposition. From January 1962 to May 1963 the activity of $^{95}Zr + ^{95}Nb$ in moss vegetation has always been greater than 100 nC/m^2. The gamma exposure from $^{95}Zr + ^{95}Nb$ is discussed. (auth)

42250 PERTECHNETATE-99m LOCALIZATION IN MAN WITH APPLICATIONS TO THYROID SCANNING AND THE STUDY OF THYROID PHYSIOLOGY. Andros, George; Harper, Paul V.; Lathrop, Katherine A.; McCardle, Robert J. (Univ. of Chicago; Argonne Cancer Research Hospital, Chicago). J. Clin. Endrocrinol. Metab., 25: 1067-76(Aug. 1965).

Since the radionuclide technetium-99m gives extremely low energy dissipation in tissue, human studies were undertaken to evaluate pertechnetate-99m as a clinical tracer material. After intravenous administration, approximately 30% of the technetium-99m is excreted in the urine over the first 24 hrs. The pertechnetate remaining in the body is evidently slowly metabolized, since the urinary excretion decreases markedly while fecal excretion increases progressively to a total of about 20% of the injected dose at 72 hrs. In normal subjects, up to 2% of the radioactivity, from intravenously injected pertechnetate-99m is accumulated by the ion-concentrating mechanism of the thyroid at 1 hr, which corresponds closely to the accumulation of radioiodide in the gland blocked with methimazole. Both iodide and pertechnetate trapping are greatly increased (10 to 20 times) in diffuse toxic goiter. The ion-concentrating mechanism may thus be studied using pertechnetate-99m, without perturbing the gland with blocking agents. Such studies indicate that the ion-concentrating mechanism is under the control of thyroid-stimulating hormone in normal glands, but is autonomous in hyperactive thyroid nodules and Graves' disease. Thirty min after administering 1 mc of pertechnetate-99m intravenously, good scans of the thyroid are obtainable with unmodified equipment, and the gland receives a radiation dosage of only 100 millirads, or 1/1000 of the dosage from 50 μC of ^{131}I. (TCO)

42251 PREPARATION OF FATTY ACIDS LABELED WITH ^{14}C FROM OCHROMONAS DANICA. Gellerman, J. L.; Schlenk, H. (Univ. of Minnesota, Austin). J. Protozool., 12: 178-89(May 1965).

Labeled fatty acids were produced by adding 10 mc acetate-1,2-^{14}C to cultures of Ochromonas danica, with a recovery of 21.4% of the radioactivity as mixed methyl esters. Individual esters, or mixtures of isomers, were isolated in amounts between 2 and 200 mg by liquid-liquid chromatography followed by gas-liquid chromatography. Several esters were obtained pure. Linoleate and arachidonate contained not more than 4% isomers; isomerism was more pronounced with C18 : 3 and C20 : 2. The effect of different culturing conditions on fatty acid yield, composition and incorporation of ^{14}C was explored. The radioactive level of acids from the preparative run varied within a factor of 3, the average being about 1 μc/mg. All analytical and preparative procedures are described in detail and discussed. (auth)

42252 EFFECT OF INTRAVENOUS CALCIUM AND OF ORALLY ADMINISTERED AMMONIUM CHLORIDE ON ^{90}Sr EXCRETION IN MAN. Spencer, Herta (Veterans Administration Hospital, Hines, Ill.); Samachson, Joseph; Hardy, Edward P. Jr.; Rivera, Joseph. Radiation Res., 25: 695-705(Aug. 1965).

The enhancement of the excretion of ^{90}Sr previously ingested with the diet was studied under controlled metabolic conditions in man with intravenously administered calcium and orally administered ammonium chloride. Although the average increase in calciuria induced by intravenous calcium was greater than that induced by ammonium chloride, intravenous calcium was ineffective, whereas ammonium

chloride significantly increased the urinary ^{90}Sr excretion. Differences in the mechanism of action of the two agents are discussed in relation to chronically ingested ^{90}Sr and acutely administered ^{85}Sr in man. (auth)

42253 EFFECTS OF ^{14}C β PARTICLES ON CHLORELLA GROWING IN A MEDIUM CONTAINING ^{14}C-CARBONATES. Karpov, V. L.; Filippov, V. F. Radiobiologiya, 5: 580-3(1965). (In Russian).

Calculated doses of radiation received by a culture of single-cell water plants grown in a medium containing $^{14}CO_2$ are presented. The data show that in obtaining water plants with a high ^{14}C content, only the β particle ionization effect need be considered, and effects related to the high mass of the ^{14}C and some others are not important. (tr-auth)

42254 $MgSO_4$ INFLUENCE ON ^{90}Sr EXCRETION FROM ORGANISMS OF SOME LABORATORY ANIMALS. Annenkov, B. N. Radiobiologiya, 5: 620-1(1965). (In Russian).

Subcutaneous administration of magnesium sulfate to rats, rabbits, and dogs, 300 mg/kg, decreased ^{90}Sr deposition in the skeleton 13 to 48%. The effect was most pronounced when the magnesium was introduced simultaneously with the ^{90}Sr or shortly after. Continued introduction of Mg for 30 days showed no protective effect. The ^{90}Sr removal caused by the Mg is attributed to increased kidney action. The ratio of ultrafilterable to bound ^{90}Sr in the blood was not changed. (tr-auth)

42255 PREPARATION OF ^{99m}Tc. I. METHODS OF PREPARATIONS AND TEST OF ^{99m}Tc PERTECHNETATE AND $^{99m}Tc_2S_7$ COLLOID AND THEIR DISTRIBUTIONS IN RATS. Kato, Sadatake; Kurata, Kunio; Sugisawa, Yoshihiko (Dainabot Radioisotope Labs., Japan). Radioisotopes (Tokyo), 14: 315-18(July 1965). (In Japanese).

^{99m}Tc was introduced as a new radioactive diagnostic agent. The methods of preparing radioactive pertechnetate and Tc_2S_7 colloid solutions for intravenous use were described. The test methods for radiochemical purities of these preparations with paperchromatogram were also described. These preparations were injected into rats and distributions of these radioactivities were measured. Pertechnetate was cleared rapidly from blood of these experimental animals and concentrated in their stomachs in the highest ratio of 5–10% of total administered dose for at least 5 hours after injection. Relatively high uptake ratio per gram of tissue was also found in the thyroid gland. Tc_2S_7 colloid was also cleared very rapidly from the blood and concentrated into the liver. More than 60% of total administered radioactivity was taken up by the liver and the level was maintained almost constantly for at least 5 hours. (auth)

42256 A BIOCHEMICAL AND GENETIC ANALYSIS OF HISTIDINE-DEPENDENT MUTANTS OF STAPHYLOCOCCUS AUREUS (thesis). Kloos, Wesley Edwin. Ames, Iowa, Iowa State Univ., 1964. 104p.

By means of ultraviolet light and penicillin selection, 85 histidine-dependent mutants were obtained from strain 655 (Pase$^-$) of Staphylococcus aureus. By ascending chromatography, an analysis was made of the Pauly-positive intermediates of L-histidine biosynthesis accumulated by mutants of S. aureus. Mutants of S. aureus were differentiated into five biochemical groups. A mutants accumulated aminoimidazole carboxamide riboside; B mutants accumulated imidazoleglycerol; C mutants accumulated imidazoleacetol; D mutants accumulated histidinol; and E and G mutants, distinguished by genetic studies, failed to accumulate Pauly-positive histidine intermediates. A comparison of the accumulations of histidine intermediates by mutants of S. aureus and S. typhimurium indicated a similar, if not identical, pathway utilized by these two bacteria for the biosynthesis of L. histidine. By means of transduction using phage 83 and three methods of analysis, a genetic map was constructed which showed the sequence of loci in the histidine operon of S. aureus to be as follows: E, A, B, C, D, G. The best-fit method, the ratio test, and a transduction analysis using the parent strain as donor all demonstrated an identical sequence of histidine loci. The mapping of loci by using the parent strain as donor was felt to be possible only because the termination of the transducing fragment carried by phage 83 was at a specific point close to the E gene of the histidine operon. The deduced order of loci in the histidine operon of S. aureus is identical to the order of loci in the histidine operon of S. typhimurium. Complementation studies based on an abortive transduction analysis is served to divide the histidine operon into nine functional units. A mutants represented three complementation units, while G mutants represented two complementation units. Each of the remaining mutants was represented by one complementation unit. (Dissertation Abstr.)

Radiation Effects

Refer also to abstracts 42394 and 42779.

42257 (COO–1080-1) EFFECTS OF IONIZING RADIATIONS ON SUBMICROSCOPIC STRUCTURES AND RESULTING ALTERATIONS IN METABOLIC FUNCTION. Final Report, September 1, 1961–December 31, 1964. Kemp, Norman E. (Michigan Univ., Ann Arbor. Dept. of Zoology). July 1965. Contract AT(11-1)-1080. 28p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Electron microscopic evidence for pycnotic changes in nuclei of epidermal cells of heavily irradiated frogs is presented. Submicroscopic damage occurred in the nuclei of some cells within a few hours after irradiation at 50,000 rads of gamma radiation. Cytoplasmic manifestations of damage appear to develop more slowly, perhaps after a day or two. Many cells of the organs examined showed no obvious submicroscopic changes during survival up to 5 days. Biochemical and autoradiographic evidence for altered patterns of uptake of radioactive glycine-^{14}C and phenylalanine-^{14}C is presented. The results indicate that 8 hours to 1 day after irradiation there is a tendency for enhanced uptake of labeled amino acids. Histochemical evidence for increased activity of acid phosphatase and alkaline phosphatase after heavy gamma irradiation of frogs is presented. Levels of gamma radiation higher than 50,000 rads will probably be necessary to cause obvious structural damage to the submicroscopic architecture of frogs within a short time after irradiation. Frogs can survive 100,000 rads for 2 days, but they are quickly killed at 200,000 rads. Biochemical and histochemical analyses appear to be more sensitive indicators of radiation damage than electron microscopy. In the future it would be advisable to look for submicroscopic changes in cells previously demonstrated to have undergone chemical change as a result of irradiation. (auth)

42258 (LA–3365) SOME BIOLOGICAL ASPECTS OF RADIOACTIVE MICROSPHERES. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). July 20, 1965. Contract W-7405-eng-36. 67p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Preliminary observations pertinent to assessing the biological effects of particulate radiation sources, particularly fissioned $^{235}UC_2$ microspheres in the size range of about 100 to a few hundred μ are reported. All pyrocarbon-coated $^{235}UC_2$ particles and about 85 percent of uncoated ones appeared to maintain their integrity for 24 hours in gastric juice. Mean transit time of uncoated spheres through the gastrointestinal tract of 57 normal adults was 34.5 ± 16.6 hours. Their high density (~10.8) does not seem to be a factor in rate of passage. When placed in situ, uncoated particles underwent disintegration and solubilization in 4 to 6 weeks; coated ones were still partially intact at 8 to 12 weeks. The disintegration process involved encapsulation, fibroblastic infiltration of the particle mass and, in case of the coated particles, vigorous macrophage ingestion of carbon. Emergent beta-ray spectra of fissioned spheres were measured and dose as a function of depth in the skin calculated and compared with measured dose using photographic emulsion dosimetry. Calculated values (based on exponential absorption) were approximately 20 percent higher than measured values.

Lesions produced on the skin of the backs of monkeys by calculated beta-ray doses (of 1300 to 52,000 rads) from fissioned spheres were examined grossly and microscopically. Doses above about 10,000 rads produced small areas of erythema which persisted for 3 weeks. Microscopically, these lesions at 6 weeks post exposure appeared of little medical importance, although both dermal and epidermal changes were discernible. (TCO)

42259 (TID-22005) PROBLEMS IN RADIATION EMBRYOLOGY. Eighth Year Progress Report, July 1, 1964–June 31, 1965. (Jefferson Medical Coll., Philadelphia, Pa.). Contract AT(30-1)-2071. 11p. Dep. mn; CFSTI $1.00 cy; $0.50 mn.

Progress is reported in studies of the effects of 125, 150, or 175 R embryonic x irradiation on longevity and postnatal biochemical and physiological processes in rats. Data are included from a study of thyroid development and function, in which ^{131}I was used as a tracer, in rat embryos irradiated on the 12th day of development; the effects of irradiation of 10-day-old embryos on protein metabolism; and the indirect effect of irradiation on embryogenesis, in which the uterus was irradiated while the ovary was shielded or after irradiation of the uterus, ovary, and oviduct. (C. H.)

42260 (TID-22115) INVESTIGATIONS ON MUTABILITY OF POLYGENES AND ON UTILIZATION OF INDUCED GENETIC VARIABILITY. Scossiroli, R. E. (Pavia Univ. (Italy). Istituto di Genetica; Catania Univ. (Italy). Istituto di Genetica). July 1, 1965. Contract AT(30-1)-2466; IAEA Contract 61/US. 66p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Results are reported from studies on the effects of treatment of seeds of wheat with doses of 1,500, 3,000, 4,000, and 8,000 R x radiation on the induction of mutations in diploid, tetraploid, and hexaploid wheat. The utilization of radioinduced mutations in plant breeding programs is discussed. Selection methods are described. Estimates of genetic variability after radiation treatment are presented for R_4 and R_5 generations of Triticum durum and the R_4 generation of T. monococcum. (C.H.)

42261 (TID-22124) RADIATION SENSITIVITY OF THE CILIATE SPATHIDIUM SPATHULA. Williams, Donald B. (Vassar Coll., Poughkeepsie, N. Y. Dept. of Biology). [1965]. Contract AT(30-1)-3102. 25p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Progress is reported on studies of the uv-sensitivity of the ciliate Spathidium spathula. Initially the microorganisms were irradiated in the log phase with 10,000 ergs/mm^2 at a rate of 23 ergs/mm^2/sec at various times during the 5 hr division cycle. The cell was found to be more radiosensitive during the first two hrs and last hr of the cycle. Chi square tests showed highly significant differences in percentage of injury between the periods early in the cell generation (0 to 20%) and those in the middle of the generation (40% and 60%) time. Autoradiographic examination following feeding with tritiated thymidine showed that macronuclear synthesis started about 40% of the way through the generation cycle and continued until the next division. Spathidia were found to be sensitive to uv when not synthesizing macronuclear DNA and insensitive when engaged in DNA synthesis. Sensitivity was increased by cell starvation and increased age. Micronucleate closes were more resistant to uv but variations with time in cell cycle sensitivity were in agreement with results with micronucleated cells. When cells were exposed to 10,000 ergs of uv, a progressive loss in the average number of micronuclei occurred with time, total micronuclear loss being observed at 15 hrs post-irradiation. Graphs and tables are presented of results. (H.G.D.)

42262 EFFECT OF WHOLE-BODY X-RAY IRRADIATION ON PHOSPHOLIPIDS OF RAT LIVER PARTICULATE FRACTIONS. Schwarz, H. P. (Philadelphia General Hospital); Dreisbach, L.; Polis, E.; Polis, B. D.; Soffer, E. Arch. Biochem. Biophys., 11: 422-30(Aug. 1965).

Examination of phospholipids of heavy mitochondrial, and other particulate fractions of livers from whole-body x-irradiated fasted rats and controls showed that the increase of phosphatidylglycerol previously reported actually took place in fractions with lysosomal and microsomal properties. Study of the in vivo incorporation of (^{32}P) orthophosphate into mitochondrial phospholipids demonstrated that phosphatidylglycerol is more strongly labeled than cardiolipin and that it retains a greater part of that label much longer in mitochondria from the irradiated rats than from controls. It is concluded that phosphatidylglycerol plays a more active metabolic role than cardiolipin and that it may be involved in protein metabolism, which can be affected by ionizing irradiation. (auth)

42263 THE EFFECT OF INVISIBLE RAYS OF THE LIGHT SPECTRUM ON HYDRATION OF SERUM PROTEINS. Marczewski, Stanislaw. Arch. Immunol. Therap. Exptl., 13: 172-7(1965).

Irradiation of blood serum from healthy young men with infrared rays lowered the value of the coefficient of hydration of serum proteins, indicating decreased electric charge of the serum protein molecules. Diminished hydration of serum proteins after infrared irradiation precedes coagulation. Coagulation occurs also in bacterial proteins; infrared rays therefore exert bactericidal action. Irradiation of serum with a mercury-quartz lamp emitting ultraviolet rays (3650 to 2378 Å) and infrared rays (500,000 to 4,000,000 Å) at first increases hydration of proteins, and then diminishes it. The increase in hydration of serum proteins in the second phase of irradiation (15 to 20 minutes) with the mercury-quartz lamp is an effect of the ultraviolet rays and indicates increased electric charge of the serum protein molecules. In the third phase (25 to 30 minutes) of irradiation with the mercury-quartz lamp only the effect of infrared rays is manifested. The effect of ultraviolet rays on hydration of serum proteins is opposite to that of infrared rays. Increased hydration of serum proteins induced by ultraviolet rays protects the serum protein molecules from the harmful action of exogenous and endogenous factors; ultraviolet rays therefore possess therapeutic properties. The increase in the values of the coefficients of hydration of serum proteins in the second phase of irradiation with the mercury-quartz lamp (15 to 20 minutes) and decrease in the values in the third phase (25 to 30 minutes) indicate that irradiation for therapy with the mercury-quartz lamp should be performed for 15 to 20 minutes; to obtain bactericidal effects irradiation should be performed for 30 minutes or longer. The observations of the coefficient of hydration of serum proteins before and after irradiation with the mercury-quartz lamp can be used to determine the effectiveness of therapy, which can be considered effective if the irradiation is followed by increase in the coefficient of hydration of the serum proteins. (auth)

42264 MORPHOLOGIC CHANGES IN THE PULMONARY PARENCHYMA AFTER SINGLE IRRADIATION WITH SMALL DOSES OF X RAYS. Stoklosa, Edmund; Bekier, Jan (Silesian School of Medicine, Zabrze, Poland). Arch. Immunol. Therap. Exptl., 13: 391-8(1965).

Morphologic lesions induced in the lungs by irradiation with single small doses of x rays (25 to 200 R) were studied experimentally in 40 rabbits, sacrificed 4, 8, 12, and 16 days after the irradiations. It was found that doses of 25 to 200 R of x rays may produce changes in the pulmonary tissues. After doses of 25 R abundant diapedesis of blood cells involving considerable area of the pulmonary parenchyma was observed. Single doses of 50 R elicited marked phagocytic cell reactions, among others in the pulmonary alveoli, leading to thickening of the interalveolar septa and sometimes deformation of the alveoli. After doses of 100 to 200 R these changes were intensified, and proliferation of connective tissue led to complete obliteration of the alveoli and distinct pleural thickening. Pulmonary emphysema and edema also occurred. All the above-described changes persisted throughout the period of observation of the animals. (auth)

42265 EFFECT OF IRIDIUM 192 RADIATION ON THROMBOATHEROSCLEROTIC PLAQUE IN THE RABBIT AORTA. Friedman, Meyer; Byers, Sanford O. (Mount Zion Hospital and Medical Center, San Francisco). Arch. Pathol., 80: 285-90(Sept. 1965).

Prior exposure of a segment of the rabbit's aorta to γ radiation from iridium-192 markedly inhibits subsequent development of atherosclerosis in the exposed segment of aorta when the animal is fed excess cholesterol, but it was not found capable of inhibiting the development of thrombo-atherosclerosis in the same segment. This difference in inhibitory effect appears to be due to the difference in the provenance and composition of the cellular components making up the two types of atherosclerosis. (auth)

42266 ANALYSIS OF INDUCED REVERSIONS IN A METHIONINE-DEPENDANT STRAIN OF SCHIZOSACCHAROMYCES POMBE. Loprieno, N.; Clarke, C. H. (Universita, Pisa, Italy; Inst. of Animal Genetics, Edinburgh). Atti Assoc. Genet. Ital., 10: 128-9(1965). (In Italian).

The mutagenic effect of uv light, nitrous acid, N-nitroso-N-methylurethan, and N-nitroso-N-methyl-N'-nitroguanidine on the met_4^-, D 19, h^- strain of Schizosaccharomyces pombe was studied by analyzing reversion to methionine independence. A genetic analysis of the induced and spontaneous revertants gave indications of mutagen specificity among the mutagens studied—most of the induced reversions were due to suppressor-mutations. Treatments with di-epoxybutane of the met_4^-, D 19 site in cells of opposite mating types (h^- and h^+) gave indication of differential response, suggesting that the mating type as such may influence DEB-induced mutability. (auth)

42267 GENETIC VARIABILITY IN QUANTITATIVE CHARACTER OF DURUM WHEAT INDUCED BY PHYSICAL AND CHEMICAL MUTAGENS. Bagnara, D. (CNEN, Rome). Atti Assoc. Genet. Ital., 10: 150-67(1965). (In Italian).

Caryopses of durum wheat cv. Cappelli were treated in 1959 with physical and chemical mutagens, i.e., 660 Rep of fast neutrons, 20 kR of x rays, and a concentration of 3.76% ethylmethanesulfonate. 100 M_1 spike-progenies were grown for each mutagen; the resulting M_2 plants supplied a bulk of 2000 caryopses, obtained bulking together samples of 4 caryopses for each one of 5 M_2 plants per M_1 progeny. Subsequently, 500 normal-looking M_3 plants were random selected and, from each one of them, one progeny of 6 M_4 plants was obtained. Control material was grown following the same scheme as above. On the better developed culm of each normal-looking M_4 plant, several characteristics were measured: culm length; length of the last internode; length of spike rachis; number of spikelets; and number of caryopses. The results showed that all treatments induced a genetic variability higher than the control (with the exception of EMS in the culm length and in the length of the last internode). In terms of genetic variability, the rate of mutagenic efficacy was fast neutrons > x rays > EMS. All treatments increased the mean length of spike rachis. Also, all treatments decreased the mean values of the two characters concerned with yield. Moreover, the hypothesis of a mutagenic activity not only at the specific genic level, but also on chromosomic structure and, generally, affecting fitness, was found to be particularly suitable to the above mentioned yield characters. EMS and fast neutrons decreased the mean values of the culm length and of the length of last internode, while x rays increased the same values. (P.C.H.)

42268 MUTAGENIC EFFECTS OF X RAYS ON PEAS. Monti, L. M. (CNEN, Rome). Atti Assoc. Genet. Ital., 10: 171-82(1965). (In Italian).

The results of the scoring of chlorophyll mutations induced by x rays (10 kR) in seeds of the line 5075 of the fodder pea Parvus, are reported. The data are discussed by comparing them with those previously obtained after treatment with DS (2‰, 20°C, 15 hours). 15 days after sowing, X_1 seedlings were subdivided into three classes according to their growth in order to test the relationship between the X_1 damage and the X_2 genetic effects. The X_1 plants were harvested by keeping separately the main stem and each branch; the opportunity of this method was confirmed by the presence of a few X_1-plants with different mutations in different branches, as observed after treatment with DS. The mutation frequency after irradiation was 3–4 times lower than that obtained after DS treatment with nearly the same percentage of survival at maturity of M_1 plants. The deviation of the mean segregation ratio of mutation in the X_1 branches (15.36%) from the expected ratio (25%) is likely due both to the chimeral nature of X_1 branches and to the deficit of recessives of some mutations. According to the DS treatment it was found that after irradiation the number of initial cells participating in the formation of the generative tissue in a single X_1 main stem is higher than in a single X_1 branch. Two observations point out a greater diplontic selection of x rays in respect of DS: on the contrary of DS results, in most cases the same type of mutation, likely due to the same mutational event, was found in different branches of X_1 plants; and a direct relationship between the three classes of M_1 seedlings and the frequency of mutations in M_2 was found after DS treatment; after X-irradiation the highest frequency of mutations was found in the middle class of damage. (auth)

42269 EFFECTS OF TRITIUM BETA RAYS ON VICIA FABA. 2. EFFECTS ON CHROMOSOMES OF APICAL ROOT-TIPS CELLS. Mauro, F. (Universita, Rome). Atti Assoc. Genet. Ital., 10: 183-4(1965). (In Italian).

Broad bean apical tips were irradiated with tritiated water to obtain chromosome aberrations induced by tritium beta rays on metaphase meristematic cells. Different exposures to tritium beta-rays (65, 130, 195, and 260 rad) and to 180 kvp x rays (75, 149, 250 rad) were used to determine the comparative effectiveness of the two radiations. RBE of tritium beta rays, as compared to x rays, calculated on the basis of radioinduced chromosome aberrations, is of the same order as the RBE = 1.4 observed in other experiments on apical tip in toto. The diversity between tritium-beta-rays and 180 kvp x rays concerning RBE and the values of induced aberrations is probably due to the different LET of two radiations and to the different importance of the indirect action of radiation. (auth)

42270 IRREVERSIBLE EFFECTS OF IONIZING RTG-RADIATION ON THE OSMOTIC PROPERTIES OF THE EPIDERMAL CELLS OF ALLIUM CEPA L. BULBS. Srb, Vladimir (Charles Univ., Hradec Kralove, Czechoslovakia). Biol. Plant., Acad. Sci. Bohemoslov., 7: 270-84 (1965).

The effect of different exposures to RTG radiation (100, 250, 500, 1000, 2500, and 5000 R) on the changes of the permeability of the epidermal cells of Allium cepa L., variety Vsetaty, bulbs was studied during three vegetation periods. Bulbs from growing plants (followed from the development phase of bulb growth) and bulbs immediately after harvesting were used for the experiments. It was demonstrated in our experiments by plasmolysis that the radioinduced changes of cell permeability were irreversible. When plasmolytic agents of non-electrolyte character (1M sucrose, 1M glycerol, 1M urea) were used, the equilibrium state (total plasmolysis) was reached more rapidly with the irradiated bulbs than with the unirradiated controls. When electrolytes were used (0.5M KNO_3, 0.5M KBr), total plasmolysis occurred less rapidly with the irradiated objects than with the controls. These relationships were manifest during the whole ontogenesis of Allium cepa L. An exposure to 100 R was sufficient in our experiments for causing the mentioned changes, proving a considerable sensitivity of the osmotic properties of the epidermal cells of Allium cepa L. bulbs to ionizing RTG radiation. Plasmolytic experiments after smaller exposures than 100 R of RTG rays are in preparation. (auth)

42271 IMMEDIATE EFFECTS OF X-RAYS ON INVERTEBRATE ANIMALS AND FROGS. Bergeder, H. D.; Boening, D. (Universitaet, Bonn). Biophysik, 2: 239-46 (1965). (In German).

Numerous types of lower animals show, in the effect of ionizing beams, immediate reactions that range from disquiet to flight. Reaction occurrence and intensity are strongly dependent on the dose, often a latency time is introduced, and with frequent repetition of low dose, fa-

tigue appears. The possibility of a relation between the reaction to irradiation and the degree of phylogenetic development of the individual concerned was discussed. (tr-auth)

42272 OBSERVATIONS ON LEUKEMIA IN WISTAR AND WISTAR FURTH RATS. Moloney, William C.; Boschetti, Antonio E.; Dowd, Geraldine (Holy Ghost Hospital, Cambridge, Mass.; Boston City Hospital; Tufts Univ., Boston). Blood, 26: 341-53(Sept. 1965).

Six-hundred and seventy-three Wistar and W/Fu rats were treated at the age of 4 months with whole body x radiation, orally administered 3-methylcholanthrene (3MCA), or a combination of these agents. All animals were followed until death, and 87% were autopsied. Among 303 autopsied animals, there were 403 benign and malignant tumors, including 28 leukemias. Differences were noted in the incidence and types of leukemia occurring in both breeds of rats. In Wistars 9 of 11 leukemias were myelogenous and eight of these followed x-ray exposure. Approximately a 10% incidence of spontaneously occurring mononuclear cell leukemia was found in W/Fu rats. Exposure to x-ray apparently decreased the occurrence of leukemia in these rodents. Following oral administration of 3MCA, 13% of W/Fu rats developed acute mononuclear cell leukemia. Results of hematologic, cytologic and histochemical studies on rat leukemia are discussed, and the possible significance of the appearance and disappearance of the distinctive mononuclear cells in the peripheral blood is pointed out. Pathologic findings indicate that the majority of deaths, other than those due to leukemia, were due to pulmonary infections and a great variety of tumors. In leukemic animals enlargement of the spleen was almost universally present and adenopathy, especially involving mediastinal and retroperitoneal glands, was frequently noted. Among 9 myelogenous leukemias in Wistar rats, green chloromatous tissues were found in five animals. Cytogenetic studies were carried out on direct preparations from the bone marrow in most of the leukemic rats in this series. Aneuploidy was noted in several animals and one W/Fu rat demonstrated a morphologically abnormal marker chromosome. In more recent studies improved techniques and use of the spleen as a source of metaphase preparations afforded better opportunities to obtain adequate chromosome preparations in leukemic rats. Further investigations are in progress and special studies are being directed to the viral and cytogenetic aspects of leukemia in the rat. (auth)

42273 DOSE-RATE AND SURVIVAL CURVES. Porter, E. H. (New York Univ., New York). Brit. J. Radiol., 38: 607-12(Aug. 1965).

A model is proposed for the effect of dose-rate of γ radiation on the survival curve. The model leads to a set of differential equations, which are solved numerically. The parameters of the model have been fitted to published data on the survival of HeLa S3 cells, and a satisfactory fit obtained. The resulting survival curves have a dose-rate dependent component together with an exponential component independent of dose-rate. Reasons are given for expecting the exponential component to be relatively independent of the oxygen effect. (auth)

42274 REPRODUCTIVE CAPACITY OF MAMMALIAN TUMOUR CELLS IRRADIATED IN VIVO WITH CYCLOTRON-PRODUCED FAST NEUTRONS. Berry, R. J.; Bewley, D. K.; Parnell, C. J. (Churchill Hospital, Oxford; Hammersmith Hospital, London). Brit. J. Radiol., 38: 613-17(Aug. 1965).

The reproductive capacity of isologous P-388 leukemic cells was determined in vivo after irradiation with fast neutrons from a cyclotron. When tumor-bearing donor animals were irradiated at 10 cm depth in tissue-equivalent phantom material, using a relatively narrow fast neutron beam, the results were indistinguishable from results when donor animals are irradiated in air using a wide neutron beam. Implications of this finding for radiotherapy of human tumors are discussed. (auth)

42275 IMMUNIZATION OF SHEEP WITH IRRADIATED LARVAE OF DICTYOCAULUS FILARIA. Jovanovic, M.; Sokolic, A.; Movsesijan, M.; Cuperlovic, K. (Inst. for the Application of Nuclear Energy in Agriculture, Veterinary Medicine and Forestry, Zemun, Yugoslavia). Brit. Vet. J., 121: 119-31(Mar. 1965).

A survey of some results obtained with ionizing radiation on larvae of Dictyocaulus filaria and irradiated larvae as a vaccine against D. filaria is given. It was established that x- and γ-rays, at a level above 40 kR attenuated infective larvae of D. filaria to such a degree that their administration did not cause any serious pathomorphological process in the lungs of the animals. The best results were obtained by double vaccination of animals of about four months of age and older. The first dose contained 1,000 irradiated larvae and the second one contained 2,000; these were administered at an interval of 30 days. The vaccine was successfully used up to 30 days after larval irradiation. Immunogenic potency was satisfactorily preserved for two months by keeping the larvae at 4 to 8°C, which included storage for one month prior to irradiation. In lambs six and eight weeks old it was found that resistance was of a lower degree as compared with the resistance obtained in older animals; however, by administering a smaller number of irradiated larvae to them in the first vaccine dose it was possible to produce a higher degree of resistance. Preliminary results have shown that γ rays could be applied successfully for the production of radiation vaccine against D. filaria. (auth)

42276 THE RESISTANCE OF L-FORM BACTERIA TO UV IRRADIATION. Shakhovskii, K. P. Byul. Eksperim. Biol. i Med., 59: 79-2(1965).

A comparison was made of the resistance of stabilized L-form bacteria to the action of shortwave ultraviolet light. Five strains of stabilized L-forms, 4 strains of cultures reverted from the L-form, and 5 strains of initial cultures of the following species of bacteria were used: Streptococcus haemolyticus, Proteus vulgaris, Salmonella typhosa, and Salmonella typhimurium. Bacterial suspensions of these strains were prepared and exposed in petri dishes (in a layer 1 to 3 mm thick) to ultraviolet light (λ = 2537 Å; intensity 20 erg/mm^2· sec) for periods of 30 sec to 30 min. Irradiated suspensions were then cultured with and without penicillin, and the number of colonies was counted. The resistance of L-forms, i.e., the number of colonies surviving various doses of irradiation, varied with the species. (ATD)

42277 CHROMOSOMES AND LEUKEMIA. Sandberg, Avery A. (Roswell Park Memorial Inst., Buffalo). CA, Med, J., 15: 2-13(Jan.-Feb. 1965).

The possible implication of diagnostic doses of x rays and ^{131}I in the genesis of leukemia, and the relation of chromosomal changes induced by radiation to leukemogenesis, is reviewed. (BBB)

42278 EFFECTS OF EARLY EXPERIENCE ON THE RESPONSE TO WHOLE-BODY X-IRRADIATION. Newton, Grant; Heimstra, Norman (Univ. of Rochester, N. Y.). Can. J. Psychol., 14: 111-20(1960).

This study was devised to test the effect of early handling and cold stress on mortality, ambulatory activity, and pattern of change in body weight of irradiated rats. A cold-stressed group was included to explore the thesis that postweaning experience with either handling or stress will produce similar results. One group (H) received early handling; a second group (T) early cold stress (5°C); a control group (XC) received radiation only. Group C served as a nonirradiated control. At 45 days of age animals of Groups H, T, and XC were subjected to 650 R of 250-kV whole-body x radiation. No significant differences in weight gain occurred between groups prior to irradiation, though males of Groups H and T were numerically lighter than controls. Following irradiation, Group XC males lost significantly more weight than did either of the experimental groups. Significant differences existed between pre- and post-irradiation, open-field, activity scores for all but Group C, and handled males. At Day 30 postirradiation, there was no significant difference in either group mortality or time of death. Mortality of each irradiated group was about 50%. Weight loss in the irradiated rat is undoubtedly

speeded by reduced food intake and increased pituitary-adrenal activity following exposure. Changes in body weight and food consumption appear to be dose dependent for a given species. These may provide reliable indices of radiation damage to the alimentary tract. Though no measure of either food intake or defecation was made, it is possible that a contributing factor to the slow rate of weight loss in irradiated males of Groups H and T was greater food intake or less excretion of intestinal contents in comparison with exposed control animals. Experimental rats began to regain weight in advance of controls implying that the former sustained less alimentary damage, permitting earlier recovery of function and better dietary assimilation. This interpretation is in accord with the earlier finding that early-handled rats assimilate a larger proportion of ingested food than do nonhandled. Generally, early handling affords a protective or anticatabolic effect in the stressed rat, suggesting increased utilization of endogenous growth hormone (STH). STH would facilitate cellular repair enabling the handled animal to retain greater body weight than its nonhandled control. Postirradiation weight change in handled males was similar in course to that of corresponding cold-stressed rats, lending support to the hypothesis that either type of treatment is capable of raising the threshold for later stress. Early experience with a cold environment evidently protected against excessive weight loss in irradiated males. Treatment of rats, for three weeks before irradiation, with aureomycin reduced the early mortality associated with gastrointestinal injury. (BBB)

42279 VERTEBRAL MALFORMATIONS INDUCED IN THE EMBRYO OF THE MOUSE BY AN IRRADIATION IN IN UTERO WITH X RAYS. Novel, Madeleine (Institut National des Sciences Appliquees, Lyon). Compt. Rend., 260: 6215-18(June 9, 1965). (In French).

A study of the frequency of the vertebral malformations induced by x rays in the mouse embryo as a function of their nature and their localization made it possible to show the differential sensitivity of some vertebral and costal rudiments at the same stage of development and independent of the radiation dose. (tr-auth)

42280 EFFECTS OF IONIZING RADIATION ON NORMAL VOLUTIN AND THAT AFFECTED BY SULFAMIDES WITH CERTAIN BACTERIA. Christov, G. (Inst. of Research in Oncology, Sofia). Compt. Rend. Acad. Bulgare Sci., 18: 169-72(1965). (In French).

The effect of ionizing radiation on sulfathiozol induced volutin was investigated in two strains of bacteria. The bacteria were exposed to doses of 5000, 20,000, and 100,000 R. The results showed no modification of the volutin inclusions. It was concluded that there was no essential difference in the composition of normal volutin and sulfathiazol-induced volutin. (J.S.R.)

42281 SOME OBSERVATIONS ON THE EFFECT OF GAMMA RADIATIONS ON THE EGGS OF HOEMONCHUS CONTORTUS (RUDOLPHI, 1803). Premvati (Univ. of Lucknow, India). Current Sci. (India), 34: 380(June 20, 1965).

The adult parasites were collected from the abomasum of sheep, washed thoroughly in distilled water, and kept in Locke-Lewis solution at 15–20°C. The mature females were selected, their uteri ruptured, and the eggs removed. With a γ source (^{60}Co) at a dose rate of 1.3×10^5 R/hr, the eggs were exposed to different doses ranging from 5000 to 50,000 R. Hatching of eggs was observed after 40 hr to allow for maximum hatching. Eggs for control experiments were also taken to the irradiation center under similar conditions so that all other factors remained the same in control and experimental egg samples. It was observed that survival of eggs was inversely proportional to the exposure dose. As the dose was increased mortality increased, and with a dose of 20,000 R only 47.7% of the eggs remained viable. The LD_{50} was calculated on the basis of 16,000 eggs at each dose. Taking control eggs as 100% viable, the mortality of eggs exposed to different doses when plotted against dose showed that eggs did not become completely sterile even after irradiation with a dose of 50,000 R. (BBB)

42282 MORPHOLOGICAL AND BIOLOGICAL CHANGES IN PLANTS INDUCED BY γ-RADIATION. Avramenko, B. I.; Ipatev, A. N.; Mushinskaya, L. G.; Savchenko, A. P. (Inst. of Genetics and Cytology, Academy of Sciences, Belorussian SSR). Dokl. Akad. Nauk BSSR, 9: 340-3(May 1965). (In Russian).

Dry, soaked and sprouted seeds were given a varying dose of ^{60}Co gamma rays directly after planting or two to three weeks before planting. With radiosensitive plants (bean, pea, kidney bean) the delay in emergence time was 6 to 14 days as compared with the sprouting time of the unirradiated controls. Resistant plants (radish, Chinese cabbage, pepper, mustard) showed a 1 to 3 day delay in emergence time as compared to the controls. The plant height decreased from 97 cm in an unirradiated mustard plant to 77 cm at a dose of 100 kR, and 74 cm at a dose of 150 kR. At doses of 100, 120, and 150 kR it was found that 7, 12, and 17% respectively of the Chinese cabbage plants formed heads. This tendency carried over into the second generation. Malformations appeared in the irradiated plant, but these defects tended to disappear with increasing maturity of the plant. The fat content in mustard seeds decreased from an average of 28.8% in the unirradiated controls to 23.5% at a dose of 120 kR, and to 23.9% at a dose of 150 kR. The fat content in Chinese cabbage seeds decreased from 27.2% in the controls to 24.9% in seeds given a dose of 150 kR. A dose of 2500 to 5000 R on tomato seeds stimulated the growth of the tomatoes, and resulted in ripening of the fruit 5 to 7 days earlier than the controls. The degree of stimulation depended on the plant culture and the weather. Conditions favoring growth resulted in a high degree of stimulation by irradiation. (TTT)

42283 THE EFFECT OF INFRARED RADIATION ON IMMUNOBIOLOGICAL REACTIVITY OF THE BODY. Duldier, A. N. (Pirogov Inst. of Medicine, Odessa). Gigiena i Sanit., No. 5, 42-6(May 1965). (In Russian).

The chronic irradiation of animals (three 10 to 20 min exposures daily for 4 to 6 weeks) with infrared radiation stimulated the phagocytic activity of leukocytes and the formation of agglutinins and increased resistance to infections. Long-term action of low intensity infrared radiation on workers intensified the immunobiologic reactivity, whereas a decrease in immunobiologic activity and an increase in incidence of nonspecific diseases was noted in persons exposed to intensive irradiation. (H.G.D.)

42284 THEORETICAL STUDIES ON THE METHODOLOGICAL PROCEDURES OF RADIATION BREEDING. III. PROCEDURES FOR OBTAINING AT LEAST TWO DESIRABLE MUTANTS IN AUTOGAMOUS PLANTS FOLLOWING SEED IRRADIATION. Yoshida, Yoshio (Kyushu Agricultural Experiment Station, Fukuoka). Heredity, 20: 37-47(Feb. 1965).

This is a continuation of two earlier reports in which theoretical considerations were made on properties of the four methods for selection in irradiated plant populations. Each of those methods, i.e., the improved ear-to-row method (method B), the one-plant-one grain method (method C), the one-plant-two grain method (method D), and the one-plant-three-grain method (method E) was shown to be more effective for detecting at least one desirable plant in X_2 generation as compared with the convention ear-to-row method. Because of difficulties, caused by factors such as soil heterogeneity and other environmental variables, in selecting a desirable mutant, it is appropriate to consider the probability of detecting at least two desirable mutants to guarantee the detection of at least one desirable mutant. Thus, methods were established for the discovery of two or more desirable mutants in X_2 from a minimum total number of X_2 plants, and/or X_1 and X_2 plants in the aggregate, which will provide economy of both labor and land. These methods were derived as follows: If m is the number of X_2 lines or of X_1 plants (seeds taken from one ear of one X_1 plant) and n is the number of plants in an X_2 line, the product mn is the total number of X_2 plants. P_1^{II} is taken as the probability of detecting at least two desirable mutants among mn plants. P_1^{II} is concerned in three different ways: (a) $P_{\frac{1}{n}}^{II}$; the probability of detecting at least one X_2 line containing at least two desirable mutants, (b) $P_{\frac{1}{m}}^{II}$; the probability of

detecting at least two X_2 lines (which contain at least one desirable mutant per line) among m lines, and (c) P_{13}^{II}; the probability of detecting at least two desirable mutants from the whole of an X_2 population. The probability of producing a desirable mutant is assumed to be equal to that of detecting a desirable mutant. Thus, for detecting at least two desirable mutants in X_2 with the smaller number of total X_2 plants, and/or X_1 and X_2 plants in the aggregate, four methods (B II, C II, D II, and E II) were established by considering three different probabilities, P_{11}^{II}, P_{12}^{II}, and P_{13}^{II}. Method B II consists of method B II_8, B II_9, B II_{10}, B II_{11}, and B II_{12}, established by considering P_{11}^{II} and used as the ear-to-row method. Method B II_9 is the most effective in method B II; i.e., in method B II_9, nine grains yielded from each ear of the X_1 plants of the number required for detecting at least one X_2 line with at least two desirable mutants are sown to obtain corresponding X_2 plants. In methods C II, D II, and E II, established by considering P_{13}^{II} and used as the bulk method, one, two, or three grains, respectively, are taken from each ear of the X_1 plants of the number required to detect at least two X_2 lines (which contain at least one desirable mutant per line) among m lines or to detect at least two desirable mutants among mn plants. The orders among methods C II, D II, and E II obtained by considering P_{13}^{II} are the same with those obtained by considering P_{13}^{II} with respect to m, mn, and m + mn. Each of the methods B II_9, C II, D II, and E II are applicable in radiation breeding. However, no single method covers all the advantages in the methods, each being superior to the conventional ear-to-row method. (BBB)

42285 THE FINE STRUCTURE OF SYMPATHETIC NEURONS IN X-IRRADIATED FROGS. Pick, Joseph (New York Univ., New York). J. Cell. Biol., 26: 335-51 (Aug. 1965).

The effects of whole body x irradiation on the fine structure of sympathetic neurons were studied in 15 unanesthetized adult frogs (Rana pipiens), as seen at intervals ranging from 1 hr to 2 weeks after single exposures to 1000 R and 2000 R. Using standard procedures, the lumbar sympathetic ganglia of experimental and 20 control animals were prepared for electron microscope examination. Radiation produced conspicuous but irregular and variable deterioration, swelling, and clearing of neuronal lysosomes. These changes may have been due to an increased permeability of lysosomal membranes, causing the entry of fluid into lysosomes and their swelling and deterioration, but a pronounced escape of lysosomal enzymes into the cytoplasm was questionable. Less frequent were the dilatation and the parallel layering or complete fusion and tight packing of the rough-edged endoplasmic reticulum. The number of vacuoles, probably derived from Golgi cisternae, was somewhat increased. These vacuoles were conjectured to serve the sequestration of damaged cytoplasmic areas. Abnormal amounts of presumptive glycogen granules occupied some axons of myelinated and unmyelinated fibers, especially of presynaptic nerve fibers. This was assumed to be due to a decreased breakdown of glycogen and probably caused the interruption of the transmission of nerve impulses in presynaptic fibers. The maximal incidence of these alterations seemingly occurred 8 days after exposure to 1000 R, and 1 hr after x-irradiation with 2000 R. Signs of recovery appeared 2 weeks after exposure to 2000 R. (auth)

42286 CLINICAL AND RADIOBIOLOGICAL OBSERVATIONS ON LATENT EFFECTS OF X-IRRADIATION ON THE THYROID GLAND. Greig, W. R.; Boyle, J. A.; Buchanan, W. W.; Fulton, S. (Univ. of Aberdeen, Scotland; Royal Infirmary, Glasgow). J. Clin. Endrocrinol. Metab., 25: 1009-14(Aug. 1965).

The function of the human thyroid which had been given 3700 to 6500 rads of x-rays (fractionated over 3 to 4 weeks) during the treatment of early laryngeal cancer was studied 1½ to 12 yr later. No cases of hypothyroidism were found in 20 patients, and radioactive iodine tracer tests, serum protein-bound iodine values, and serum cholesterol levels were normal. Experiments in 168 rats showed that x-ray doses up to 1600 rads (single delivery) had no effect on the iodide trapping function of the thyroid for periods up to 10 months after irradiation. In contrast, similar doses of x-rays permanently impaired the capacity of the rat thyroid cells to multiply in response to a goitrogenic challenge (thyroid cell reproductive integrity). The hypothesis is advanced that, while inhibition of thyroid cell turnover may be of little consequence in the normal thyroid because it has a low mitotic index, it is probably the mechanism underlying the pathogenesis of the high incidence of hypothyroidism which follows treatment of thyrotoxicosis (in which the gland has a high mitotic index) with radioactive iodine (^{131}I). (auth)

42287 CORRELATIVE STUDIES OF GROWTH HORMONE AND INSULIN PLASMA CONCENTRATIONS WITH METABOLIC ABNORMALITIES IN ACROMEGALY. Beck, Paul; Schalch, Don S.; Parker, Mary L.; Kipnis, David M.; Daughaday, William H. (Washington Univ., St. Louis). J. Lab. Clin. Med., 66: 366-79(Sept. 1965).

Growth hormone concentrations were measured in the plasma of 59 individuals with acromegaly. In addition, 12 acromegalic patients were studied during oral glucose, intravenous insulin, and intravenous tolbutamide tolerance tests for changes in blood glucose and plasma insulin, nonesterified fatty acids (NEFA), and growth hormone concentrations. The acromegalic subjects had higher than normal plasma growth hormone concentrations which did not change following hypoglycemia or hyperglycemia to the same degree as those of the control subjects. As a consequence of chronic hypersecretion of growth hormone, the acromegalic patients manifested impaired glucose tolerance, despite a mean plasma insulin response which was three times normal. This antagonism to insulin cannot be attributed to alterations in fasting plasma NEFA levels. (auth)

42288 THE EFFECT OF RADIOPHOSPHORUS DECAY ON CISTRON FUNCTION IN BACTERIOPHAGE T4. I. LONG-RANGE AND SHORT-RANGE HITS. Harriman, Philip D.; Stent, Gunther S. (Univ. of California, Berkeley). J. Mol. Biol., 10: 488-507(Dec. 1964).

Survival of cistron function after decay of incorporated ^{32}P atoms was investigated by infecting non-permissive host bacteria jointly with a nonradioactive rII or am T4 mutant and with highly ^{32}P-labeled T4 am^+ wild-type phage, and then following upon radioactive decay the loss of ability of the wild type to complement growth of the conditionally lethal mutant phage in the same cell. The function of each of 11 different viral cistrons was abolished by ^{32}P decay at about half the rate of loss of viability of the whole phage. The relative ^{32}P decay sensitivity of one-half cannot represent the functional inactivation of about half of the viral genome by each lethal ^{32}P disintegration, since the ability of the wild-type phage to complement a variety of am double mutants is lost only slightly faster than, and never at twice, the rate of loss of complementation of single am mutants. Nevertheless, the sensitivity of multiple cistron function does increase as more and more am mutant cistrons are brought into play, until in the case of complementation of a sextuple am mutant, joint functional survival of six cistrons is lost at 0.8 the rate of loss of viability of the whole am^+ phage. These observations are interpreted by postulating two types of lethal ^{32}P disintegrations, long-range hits that cause functional inactivation of the whole, and short-range hits that inactivate only part of the viral genome. About half of the lethal ^{32}P hits are of the short-range type if decay proceeds at −196°C or +4°C. The frequency of short-range hits is sharply reduced, however, if the free radical trap 2-aminoethyl isothiouronium bromide (AET) is present during decay at 4°C, suggesting that short-range hits represent radiochemical lesions, in the production of which free radicals play an important part. Calculation of the fraction of all ^{32}P disintegrations that inactivates a given cistron by short-range hits shows that this fraction is equal to about half the total share of the whole genome represented by that cistron. This coincidence suggests that half the ^{32}P disintegrations occurring within a viral cistron produce sublethal damage preventing its functional expression, unless the damage had first been

erased by a repair process which can proceed in the infected cell. Short-range hits would then correspond to lesions in the viral DNA that render nonerasable, and thus permanently fix, all sublethal cistron damages that have already occurred, or may yet occur, upon further decay. (BBB)

42289 THE INDUCTION OF MUTATIONS BY IONIZING RADIATION IN BACTERIOPHAGE ΦX174 AND IN ITS PURIFIED DNA. Van Der Ent, G. M.; Blok, Joh.; Linckens, E. M. (National Defense Research Organization TNO, Rijswijk, The Netherlands). Mutation Res., 2: 197-204 (June 1965).

By x-irradiation of a mutant of the Escherichia coli bacteriophage ΦX174, with a more extended host-range than the wild type, back mutations could be induced. During irradiation the bacteriophage protein was protected against indirect effects by means of thiourea. The mutagenic efficiency was about 2×10^{-4} per lethal hit. The same type of mutation was found in the progeny produced by irradiated DNA in bacterial spheroplasts. In these experiments the DNA was separated from the phage protein by extraction with phenol, and irradiated in aqueous solution at a concentration of 5 μg/ml. Under these conditions the effect appeared to be due to radicals produced in the water since the inactivation dose was very small, namely only about 40 rad in very pure preparations. The number of mutants produced per lethal hit was insignificant in the presence of oxygen, but rose to 2×10^{-4} when oxygen was replaced by hydrogen. (auth)

42290 THE RELATION BETWEEN THE EXPONENT OF DOSE RESPONSE FOR CHROMOSOME ABERRATIONS AND THE RELATIVE CONTRIBUTION OF TWO-TRACK AND ONE-TRACK PROCESSES. Neary, G. J. (Medical Research Council Radiobiological Research Unit, Harwell, Berks, Eng.). Mutation Res., 2: 242-6(June 1965).

Simple formulas for converting a dose response for chromosome aberration yield expressed as a power law to the equivalent quadratic expression are given. At doses of 100 R or so of hard x or γ radiation, half or more of the total yield of isochromatid breaks is due to a two-track process. Some implications of dose response for aberration yield are briefly mentioned. (auth)

42291 CHROMOSOME ABERRATIONS AND THE MITOTIC CYCLE IN TRILLIUM ROOT TIPS AFTER X-IRRADIATION. Grant, C. J. (Oxford Univ.). Mutation Res., 2: 247-62(June 1965).

The mitotic parameters of root tips of five species of the Trilliaceae were determined. A small x-ray dose (50 R) causes a delay to the division of nuclei synthesizing DNA at the time of irradiation, but has no effect on those which have completed DNA replication. Elongation of S by cold treatment of nuclei containing tritium label has the same effect. The pattern of aberrations following a dose of 50 R is related to the mitotic cycle. The change from chromosome- to chromatid-type aberrations is correlated with the onset of DNA replication. Sub-chromatid effects indicate that the processes of mitosis are initiated before cytological prophase is distinguishable. The distribution of aberrations within and between chromosomes in the interphase nucleus is discussed. It is concluded that the present observations are compatible with Revell's exchange hypothesis for chromatid-type aberration formation, and it is shown that the apparent differences between Trillium and other material are explicable in terms of its longer mitotic cycle. (auth)

42292 IMMUNITY AGAINST TUMOUR TISSUE. Koldovsky, P. (Inst. of Experimental Biology and Genetics, Prague). Neoplasma, 12: 113-18(1965).

The use of irradiated tumor cells in attempts to induce immunity to the tumor and unsuccessful attempts to immunize mice against x-ray induced leukemia are reviewed. (BBB)

42293 THE BEHAVIOR OF CORTICAL LIPIDS AND THE CELLULAR CHANGES IN THE ADRENAL ZONE IN ANIMALS IRRADIATED BY VARIOUS DOSES OF ^{60}Co γ RAYS. Trinci, M. (Universita, Rome). Nuntius Radiol., 31: 124-34(Feb. 1965). (In Italian).

One of the first reactions of organisms to any type of stress is a change in adrenal activity. The behavior of the cortical lipids was studied in animals irradiated by different modalities with ^{60}Co gamma rays. Lipids are the substratum necessary for the secretion of the corticoadrenal hormones. The cellular changes that occurred in fasciculated and reticulated adrenal zone were also evaluated. (auth)

42294 STATISTICAL INVESTIGATION OF LEUKEMIA AUTOPSIES IN JAPAN. Seno, S. (Okayama Univ. Medical School, Japan). Pathol. Microbiol., 27: 684-96(1964).

A statistical investigation of 2475 autopsy cases of leukemia in Japan is reported with an analysis of the type of leukemia, incidence in males and females, and the age distribution. Recent changes in leukemia incidence among those exposed to atomic bombing in Hiroshima and Nagasaki are also reported. The death rate from leukemia of those exposed to atomic bombing increased rapidly after the exposure and reached the max after 3 to 5 years in both Nagasaki and Hiroshima. Thereafter, the number of leukemia cases remained at almost the same level. Leukemia seen among those exposed to atomic bomb is predominantly myeloid in type. This is probably due to the fact that the radioisotopes remain in bone and the bone marrow cells are selectively affected by the radiation. Acute and chronic forms have appeared in the same range from the beginning, suggesting that the two types of leukemia are induced by a different mechanism in a similar incubation time. Intense irradiation of some limited area of the body may induce the acute form whereas chronic leukemia is likely produced by low doses of whole-body irradiation. About 84% of all leukemias occurring in people exposed in Hiroshima, and about 50% in Nagasaki, developed in persons exposed within 2000 m from the hypocenter. Thus radiation effects are implicated etiologically with the leukemia incidence. Leukemia incidence of those who immigrated into Hiroshima or Nagasaki after the atomic bombing or entered transiently just after the bombing is also considered. Among 44,126 subjects entering Hiroshima two weeks after the bombing either permanently or temporarily, forty cases of leukemia were found. Results show that the radiation effect was greatly reduced 3 to 6 days after the bombing. (TCO)

42295 KINETICS OF X-RAY AND HEAT INACTIVATION OF φX174 RF-DNA. Ginoza, W.; Miller, R. C. (Pennsylvania State Univ., University Park). Proc. Natl. Acad. Sci. U. S., 54: 551-8(Aug. 1965). (TID-22098)

Replicative factor-DNA of φX174 was inactivated by x rays and heat with a killing efficiency of about 0.25, suggesting that the genome is made up of critical and noncritical targets. It appears that one lesion alone in the critical target kills the viral activity, while surviving RF bearing several lesions only in the noncritical target can still restitute a normal replica of the viral genome. Restitution mechanisms are discussed. (auth)

42296 A CASE OF RETICULOENDOTHELIOSIS WITH LEUKEMIC MANIFESTATION. Okada, Kosuke; Kamada, Nanao; Ito, Kazuro; Tanaka, Nobuo (Hiroshima Univ.). Proc. Res. Inst. Nucl. Med. Biol., No. 6, 44-73(1965). (In Japanese).

A case of reticuloendotheliosis with leukemic manifestation occurring in a 28-year-old female, one of A-Bomb survivors (3.0 km from the hypocenter), is described and discussed in view of clinical findings. The disease developed with pain in the extremities and lumbar region, slight fever, and subcutaneous bleeding in the end of January, 1963. The course was acute and rapid hepatosplenomegaly and a lymphnode-swelling in the left supraclavicular region appeared terminally. Examination of the peripheral blood revealed 315×10^4 per cmm of RBC, 12.2g/dl of Hb, 6,200 per cmm of thrombocytes and 4,800 per cmm of WBC. The classification was 16% of pathological immature cells, 23.5% of granulocytic cells and 60% of lymphocytes, accompanied with 11 erythro-

blasts per 200 leukocytes. The bone marrow contained 62.6% of pathological immature cells. The hematological findings and clinical course were moderately improved by the corticosteroid hormones, 6MP and mitomycin therapy. Before death the peripheral WBC increased from 900 to 27,000, 86.5% of which were the pathological immature cells. Microscopic findings are discussed. Thirty-five bone marrow cells in 41 observed cells showed 45 chromosomes. The autopsy revealed marked proliferation and infiltration of the reticuloendothelial cells in the lymphnodes, spleen, liver, bone marrow and other organs. (H.G.D.)

42297 EXPERIMENTAL STUDY ON THE ERYTHROCYTE LIFE SPAN OF X-IRRADIATED RABBITS. Takahashi, Hiroshi; Nakanishi, Sumio; Ohkita, Takeshi. Proc. Res. Inst. Nucl. Med. Biol., No. 6, 74-86(1965). (In Japanese).

Erythrocyte life span was studied in rabbits exposed to x rays in single or in six divided doses (600 R). Erythrocytes were labeled with ^{51}Cr or ^{59}Fe. The erythrocytes in non-irradiated recipients tagged with ^{51}Cr showed somewhat shortened apparent half survival time on 30th day after the exposure of rabbits to 600 R of x rays in six divided doses given on six consecutive days. Erythrocytes tagged with ^{51}Cr on 28th day after a single exposure showed slightly shortened apparent half survival time in the recipients. In using ^{59}Fe labels, the potential life span of the rabbit erythrocytes irradiated in single dose nine days previously, was shorter than that of non-irradiated rabbits. (H.G.D.)

42298 LOW-DOSE EMBRYONIC X IRRADIATION IN MICE AND SOME SEASONAL EFFECTS IN THE PERINATAL PERIOD. Jacobsen, Lars (University Inst. for Human Genetics, Copenhagen). Radiation Res., 25: 611-25 (Aug. 1965).

Neonatal and postnatal growth and survival rates in mice were determined after maternal gestational whole-body x irradiation on the eighth day of pregnancy with doses of 0, 5, 20, and 100 R. It was demonstrated that, in the inbred strain examined, exposure to 100 R resulted in statistically significant reduction of the maternal gestational gain in weight, decreased litter size, and increased frequency of abortion. Further, unaltered average birth weights were observed, and, for all the irradiated groups, increased neonatal survival and postnatal weights during the first 20 days were observed. It was concluded that increased postnatal weight, after exposure in utero to 100 R, may be the result of interaction between a physiological effect of the radioinduced decreased litter size and an activation of the regeneration processes (possibly initiated on a genetic basis). The results emphasize the necessity of simultaneous assessment of the possible seasonal influence on the biological conditions investigated, in the study of low-dose irradiation. The results also suggest that the season probably also exerts an influence on the incidence of abortion and the litter size. (P.C.H.)

42299 EARLY CHANGES IN AUTONOMIC RESPONSES AFTER CRANIAL GAMMA IRRADIATION IN THE BURRO. Naitoh, P.; Engel, R. E.; Spurrell, F. A. (Univ. of Minnesota, St. Paul). Radiation Res., 25: 626-36(Aug. 1965).

The acute effects of single whole-brain cobalt-60 γ irradiation on heart rate, rectal temperature, and respiration rate were examined on adult male burros. Radiation doses of 200, 400, 500, and 600 R were used. Slight fever was noted as the first autonomic response to exposure. An increase of heart rate was a relatively late-appearing abnormality. Immediate cause of death was respiratory paralysis. The median effective dose for these autonomic changes would be about 400 to 500 R at a dose rate of less than 17 R/min. The burros would not undergo enduring significant physiological changes with doses less than 400 R. It was concluded that burros have particularly radiovulnerable adult CNS with respect to early manifestation of CNS disorder. (auth)

42300 SWELLING AND SHRINKAGE PROPERTIES OF HOUSEFLY SARCOSOMES AFTER IN VIVO EXPOSURE TO X RAYS. Carney, G. C. (Chalk River Nuclear Labs., Ontario, Can.). Radiation Res., 25: 637-45(Aug. 1965).

The swelling behavior of sarcosomes suspended in unbuffered 0.1M KCl solution was studied after in vivo exposure to x rays in the dose range 35 to 100 kR. The irradiated sarcosomes swelled more rapidly than the controls and at a rate proportional to dose. Reversal of swelling was obtained by the addition of ATP in the form of its acidic disodium salt. Neutralized ATP had no effect on the swelling rate. The contraction of sarcosomes in response to ATP was less pronounced after in vivo irradiation. The difference between treated and control sarcosomes with respect to their swelling behavior and their response to ATP is discussed in relation to their energy-supplying function and the depression in wing-beat frequency which results from irradiation. (auth)

42301 THE INFLUENCE OF IN VITRO IRRADIATION OF BLOOD ON RED CELL SURVIVAL AFTER AUTO AND HOMO TRANSFUSION OF CELLS LABELED WITH ^{59}Fe OR ^{51}Cr. Schnappauf, Hp.; Joel, D. D.; Chanana, A. D.; DiGiacomo, R.; Cronkite, E. P. (Brookhaven National Lab., Upton, N. Y.). Radiation Res., 25: 646-54(Aug. 1965). (BNL-8680).

Bovine red blood cells were irradiated in vitro, tagged with ^{51}Cr, and reinfused. The decrease in ^{51}Cr activity of blood was more rapid in animals receiving irradiated cells than in the controls. At doses between 50 and 200 kRads, the rate of decrease in radioactivity was dose-dependent. With ^{59}Fe labeling it was found that the radiosensitivity of bovine red blood cells increases with age. Red cells 7 to 12 days of age were found to be highly resistant to the effects of in vitro irradiation. From the ^{59}Fe data the conclusion is drawn that ^{51}Cr is a valid marker for determining the radiosensitivity of red blood cells as measured by intravascular survival. (auth)

42302 ANTIGENIC THRESHOLDS OF ANTITOXIN RESPONSES ELICITED IN IRRADIATED MICE WITH COMPLEXES OF TETANUS TOXIN AND SPECIFIC ANTIBODY. Hess, Max W.; Terres, Geronimo; Stoner, Richard D. (Brookhaven National Lab., Upton, N. Y.). Radiation Res., 25: 655-67(Aug. 1965).

Enhanced primary tetanus antitoxin responses were obtained in nonirradiated and irradiated mice immunized with active tetanus toxin in complex at equivalence (neutralization point for the toxin) with isologous antitoxin as compared to antibody responses elicited with the same amount of formalin-treated toxin only. The antigenic threshold dose for complexed toxin needed to elicit detectable primary antitoxin responses was lower by a factor of approximately 125 in nonirradiated mice and of 1900 in irradiated mice than the threshold doses required with toxoid only. Immunization with relatively minute amounts of toxin–antitoxin in complex did not elicit primary antibody responses but provided more effective sensitization than greater amounts of toxoid only with regard to the subsequent capacity of both nonirradiated and irradiated animals to give secondary antibody responses to booster injections of fluid tetanus toxoid. The minimal antigenic threshold dose for complexed toxin required to elicit secondary responses in both nonirradiated and irradiated animals was lower by a factor of about 4 than for active toxin only. With increasing amounts of toxin only and equal amounts of toxin in complex, toxin (antigen only) appeared to be more effective in eliciting secondary antitoxin responses. (auth)

42303 EMBRYONIC LETHALITY OF VARIOUS MOUSE STRAINS AS A CONSEQUENCE OF X-IRRADIATION-INDUCED INJURIES OF THE FATHER'S SPERMATOZOA. Froelen, Hakon (Research Inst. of National Defense, Sundbyberg, Sweden). Radiation Res., 25: 668-73(Aug. 1965).

Two mouse strains differing greatly in somatic sensitivity to irradiation were found to have a corresponding difference in sensitivity of the spermatozoa to ionizing irradiation. This sensitivity was expressed as a higher mutation frequency in the spermatozoa of males from the somatically more sensitive group. (auth)

42304 THE INFLUENCE OF VARYING DOSE AND REPETITIVE SHORT SESSIONS OF EXTRACORPOREAL IRRADIATION OF THE BLOOD ON THE PRODUCTION OF LYMPHOPENIA. Sipe, C. R.; Chanana, A. D.; Cronkite, E. P.; Joel, D. D.; Schnappauf, Hp. (Brookhaven National Lab., Upton, N. Y.). Radiation Res., 25: 684-94(Aug. 1965). (BNL-8681).

Repetitive short sessions of extracorporeal irradiation (ECI) spread out over days or weeks were more efficient in producing a lymphopenia than continuous ECI and much safer, since the probability of inducing hemolysis by radiation injury to the red cells was diminished. Transit doses as low as 15 Rads were effective in producing a lymphopenia, but after a few weeks recovery of larger lymphocytes began, suggesting compensatory mechanisms for producing cells more rapidly or the development of radioresistant clones of proliferating lymphocytic cells. The most efficient schedule of ECI to produce lymphopenia in respect to transit dose, exchange of blood volumes, and repetitive sessions is not known, nor is it practical to establish this in any reasonable experimental period. However, it is clear that recovery may begin during continuous ECI when transit doses are low. (P.C.H.)

42305 THE RADIOSENSITIVITY OF SNAKES AND BOX TURTLES. Cosgrove, G. E. (Oak Ridge National Lab., Tenn.). Radiation Res., 25: 706-12(Aug. 1965). (ORNL-P-256).

Whole-body x-ray exposures in snakes and box turtles maintained at 23°C resulted in an LD_{50} of 300 to 400 R for snakes and 850 R for turtles. The figures for the box turtle represent the internal dose, which averaged 21% less than the external dose because of the shielding action of the shell. The course of the acute radiation syndrome in snakes and turtles is prolonged, with delayed and prolonged hemopoietic depression, necessitating the use of 90 days in snakes and 120 days in turtles for assessment of acute radiation lethality. (auth)

42306 ANTITOXIN-LOCALIZING METHOD IN DETERMINING ANTILOCALIZATION IN X-IRRADIATED AREAS OF RABBITS. Kahn, Reuben L.; Botzler, Richard G.; Eisses, John F. (Univ. of Michigan, Ann Arbor). Radiation Res., 25: 713-24(Aug. 1965).

An investigation was made on differentiation of the degree of localization of injected protein in x irradiated and in nonirradiated areas of rabbits. The procedure used was the antitoxin-localizing method. A restricted amount of horse serum diphtheria antitoxin was injected in irradiated areas of rabbits and in corresponding areas of controls for the neutralization of homologous toxin. In the nonirradiated rabbits the antitoxin generally failed to neutralize the toxin; in the irradiated rabbits it usually neutralized the toxin. Antitoxin apparently became localized in the injected areas of the nonirradiated animals and as a result did not reach the toxin fast enough, but it did not become localized in the irradiated animals and thus neutralized the toxin. The antilocalizing aspect of irradiation by use of the antitoxin-localizing method was studied. For a given toxin dose, a particular dose was required for each lot of antitoxin, when injected in irradiated areas of rabbits and in controls, to demonstrate differences in localization and in neutralization of the toxin. The use of the same ratios of antitoxin and toxin, but different amounts compared with those commonly used in the antitoxin-localizing method, led to some antilocalization of injected antitoxin in irradiated areas. The size of the irradiated area affected the rapidity of escape of the injected antitoxin; a 12-cm area permitted a greater escape of the antitoxin and milder toxin lesions than a 4-cm area. (auth)

42307 INFLUENCE OF LOW IRRADIATION DOSES ON SOME PHASES OF DEOXYRIBONUCLEOPROTEIN STRUCTURES. Ivannik, B. P.; Komm, S. G.; Spitkovskii, D. M.; Tseitlin, P. I. (Inst. of Experimental Biology, Academy of Medical Sciences, USSR; Moscow Inst. of Medical Radiology). Radiobiologiya, 5: 491-3(1965). (In Russian).

To determine the effect of ionizing radiation on aggregation, 0.1 M DNP was x irradiated in 0.7 M NaCl solution and deposited in the surface of 0.14 M NaCl. Instead of a definite phase boundary with distinct elastic properties, the irradiated material formed filaments, which quickly disintegrated. The explanation is not yet clear, but the effect is considered due to intermolecular forces. (IIC-M.G.)

42308 ACETYLCHOLINE CONTENT AND CHOLINESTERASE ACTIVITY IN THE BLOOD OF RATS EXPOSED TO ^{90}Sr. Fedorova, A. V. (Research Inst. of Radiation Protection, Leningrad). Radiobiologiya, 5: 501-4(1965). (In Russian).

The serum acetyl choline and cholinesterase activity in male white rats given, daily, 8×10^{-3} or 2×10^{-4} μC of ^{90}Sr were different after muscle loading than before. Unirradiated animals showed no differences. (IIC-M.G.)

42309 CHANGE OF OXIDATION PROCESSES IN INSECTS UNDER THE INFLUENCE OF γ RAYS. Kalmykov, P. G. (Kirov Military Medical Academy, Leningrad). Radiobiologiya, 5: 505-10(1965). (In Russian).

Gamma irradiation (^{60}Co) of winged flies (Protophornia terrae-novae R.D.) and also the eggs, larvae, and pupal stages to 100 to 3000 R decreased the oxygen consumption. The depression continued throughout metamorphosis and subsequent generations regardless of the stage that was irradiated. Breathing was depressed less in irradiated flies poisoned with cyanide than in unirradiated. The slight depressing action of HCN on breathing in irradiated flies indicates that gamma irradiation has a destructive effect on cytochromoxidase. (tr-auth)

42310 ON THE LOCATION OF S-REACTIVE PROTEIN FORMATION INDUCED BY IRRADIATION DAMAGE. Petrov, R. V.; Zemskov, V. M.; Pashinin, P. M. Radiobiologiya, 5: 511-13(1965). (In Russian).

The peripheral blood of rabbits gamma-irradiated (^{60}Co) to 600 to 1000 R contained S-reactive protein after 6 to 15 hr. The substance appeared earlier in animals that died from shock. The substance appeared in the vena cava and the portal and hepatic veins simultaneously and in approximately equal amounts, and an hour earlier in the arterial blood. (tr-auth)

42311 CYTOLOGICAL ANALYSIS OF THE EFFECTS OF HIGH-ENERGY PROTONS. VI. COMPARISON OF THE EFFECTS OF 660 Mev PROTONS AND ^{60}Co γ RAYS. Ponomareva, V. L. (Inst. of Industrial Hygiene and Occupational Diseases, Moscow). Radiobiologiya, 5: 514-18 (1965). (In Russian).

Blood formation was affected less in rats irradiated to 500 rad with 660-Mev protons than in those irradiated with ^{60}Co gamma. The degree of damage was less and regeneration began earlier. (tr-auth)

42312 DYNAMICS OF CHANGES IN COAGULATIVE AND FIBRINOLYTIC BLOOD SYSTEM OF DOGS IN ACUTE RADIATION SYNDROME. Ponomarev, Yu. T. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya, 5: 519-21(1965). (In Russian).

Fifteen dogs (6–9 kg) were whole-body x irradiated to 800 R and bled, under narcosis, several times. Determinations of blood constituents showed that qualitative changes in the fibrinogen and changes in fibrinolytic activity of the blood may contribute to the onset of the hemorrhagic syndrome in acute radiation sickness. (IIC-M.G.)

42313 ON THE MECHANISM OF THE GAS-EXCHANGE DISTURBANCE IN DOGS DURING RADIATION SICKNESS INDUCED BY ^{210}Po. Fedotov, V. P.; Bezin, G. I. Radiobiologiya, 5: 522-4(1965). (In Russian).

Acute radiation sickness in dogs induced by ^{210}Po is characterized by severe disturbance in gas exchange, which develops in the latent period (1 to 6 hr). The tissue oxygen supply decreases progressively to 40% of the initial level, but oxygen consumption decreases from 59 to 75%. The lack of correlation is related to the higher rate of transfer of oxygen from the blood to the tissue. The disturbance is manifested chiefly in the early and progressive decrease in the rate of hematopoiesis. In the early stages the oxygen capacity of the blood decreases, and it is not oxygenated in the lungs. (tr-auth)

42314 METABOLISM OF PHOSPHORUS COMPOUNDS IN SMALL INTESTINES OF MICE FOLLOWING STARVATION AND REPEATED IRRADIATION. Orlov, A. S. (Inst. of Radiation Protection, Ministry of Public Health, Leningrad). Radiobiologiya, 5: 528-32(1965). (In Russian).

Irradiation of mice to 50 R decreased the total DNA content of the small intestine but had no effect on the amount per gram of tissue. Inclusion of ^{32}P decreased but the inorganic phosphate and the rate of biosynthesis were not changed. A full day of fasting did not affect the DNA in the controls, but DNA synthesis was sharply depressed and its concentration increased; these effects were small in the irradiated mice. Inclusion of ^{32}P in the tissue and the specific activity of the inorganic phosphate increased in fasting irradiated mice but changed little in the controls. Irradiation to 700 R decreased the content and depressed the synthesis of DNA in the small intestine. Preliminary irradiation to 50 R stabilized the DNA content of the small intestine. In fasting mice this effect was absent, but changes in inorganic phosphate metabolism indicate an effect of the preliminary irradiation in these mice also. (tr-auth)

42315 PHAGOCYTIC ACTIVITY OF LEUKOCYTES DURING ACUTE EXPERIMENTAL RADIATION SYNDROME. Almazov, V. A.; Mamaev, N. N. (Pavlov Medical, Leningrad). Radiobiologiya, 5: 533-5(1965). (In Russian).

In the first hour after irradiation, rabbits showed decrease in phagocytic activity of the leukocytes. Three to five days after irradiation to 700, 800, and 900 R, an increase in phagocytic activity occurred, the degree of which paralleled the irradiation dose and was due to changes in cell membrane permeability. (tr-auth)

42316 EFFECTIVENESS OF PRIMARY IMMUNIZATION AND REVACCINATION WITH LIVE ANTI-BRUCELLOSIS VACCINE IN AN ORGANISM DAMAGED WITH INCORPORATED SUBSTANCES. Lvitsina, G. M. Radiobiologiya, 5: 540-2(1965). (In Russian).

A single dose of 0.5 μC per kilogram of ^{210}Po or 0.05 μC of ^{90}Sr to guinea pigs did not affect antibody production in the primary immunization. On re-immunization the antibody level decreased 2- to 3-fold compared to the controls. (tr-auth)

42317 INFLUENCE OF γ IRRADIATION DOSES OF 25 TO 50 R ON NUCLEAR STRUCTURE OF HUMAN CELLS IN TISSUE CULTURE. Kozlov, V. M. (Inst. of Biological Physics, Moscow). Radiobiologiya, 5: 543-6(1965). (In Russian).

Quantitative analysis of chromosome rearrangement occurring after 25 to 50 R of gamma irradiation of cells in a tissue culture showed that cells are most radiation-sensitive in the synthesis phase. The cell cycle lasted 60 hr after doses of 25 to 35 R and 70 hr after 40 to 50 R. The ratio of types of chromosome rearrangements typical of spontaneous mutation was the same. (tr-auth)

42318 POTATO MUTATIONS INDUCED BY IRRADIATION OF VEGETATIVE PARTS OF THE PLANTS. Solomko, E. A. (Inst. of Cytology and Genetics, Novosibirsk, USSR). Radiobiologiya, 5: 547-55(1965). (In Russian).

The vegetative parts of potato plants were exposed to 400–8000 R of x rays, 1500–3000 R of gamma rays, and 1×10^{19} to 4×10^{19} n/cm^2 of thermal neutrons. X-ray doses of 2 to 6 kR caused the widest range of mutations. Gamma doses of 3 kR and more resulted in deformed, biologically inferior forms. Gamma rays caused the highest percentage of changes with the least variety. (IIC-M.G.)

42319 IRRADIATION DAMAGES OF INTERPHASE NUCLEI IN THE CELLS OF DEVELOPING MISGURNUS FETUSES. Pankova, N. V. (Inst. of Biological Physics, Moscow). Radiobiologiya, 5: 555-8(1965). (In Russian).

Radiation damage in interphase nuclei of the gastrula stage of groundling was the same as on embryos irradiated in the 4-cell and late blastula stage. Death of irradiated embryos is apparently due to cell nuclear degeneration. In irradiated embryos the chromosomes retained the ability to form nucleoli. (tr-auth)

42320 ON THE DEVELOPMENT OF IRRADIATED HEN BLASTODERM. Korogodina, Yu. V. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya, 5: 559-61(1965). (In Russian).

Prolonged observations on the development of irradiated blastoderm of hen eggs confirmed assumptions of high radiation sensitivity of differentiating cells compared to nondifferentiating. The irradiated blastoderm cells that showed delay in fission but no loss of viability retained the ability to differentiate further. (tr-auth)

42321 MORPHOLOGICAL CHANGES IN THE NERVOUS SYSTEM OF DOGS IRRADIATED BY HIGH-ENERGY PROTONS. Bibikova, A. F.; Lebedev, B. I. Radiobiologiya, 5: 562-6(1965). (In Russian).

In dogs dying or sacrificed at the peak of the radiation syndrome resulting from a single whole-body irradiation with 510-Mev protons, dystrophic changes in the central and peripheral nervous system were similar to those occurring after x and gamma irradiation. The most common exceptions were brain and subarachnoidal hemorrhages. The specificity of action of protons of this energy in a single whole-body irradiation showed up in different disturbances of the brain circulation. Thus, the higher the total dose, the more strongly it was expressed. The nature of the observed changes in the vessels and the glial elements appeared in the distinct disruptions of the nutrition in the nervous system. (tr-auth)

42322 DESAMINATION OF ADENINE IN DNA UNDER THE INFLUENCE OF FAST NEUTRONS. Tokarskaya, V. I. (Inst. of Biological Physics, Moscow). Radiobiologiya, 5: 566-70(1965). (In Russian).

A qualitative difference was observed in the action of gamma rays and fast neutrons, in 10 kR dose, on the DNA of bean seeds. The nucleotide DNA content of the irradiated seeds was within normal limits before and after both irradiations. After the seeds had soaked in water for 24 hours at room temperature, gamma irradiation caused a decrease in the pyrimidine nucleotides, particularly thymidine. Neutron irradiation decreased the amount of adenine with simultaneous appearance of hypoxanthine. The neutron irradiation data indicate localized damage to the structure of the DNA nitrogeneous bases with substitution of pairs in synthesis of the molecule and therefore a change in the DNA coefficient of specificity and cell nonviability. (tr-auth)

42323 LIPOXIDASE ACTIVITY IN γ-IRRADIATED SEEDS. Kuzin, A. M.; Merkulov, A. S. (Inst. of Biological Physics, Moscow). Radiobiologiya, 5: 571-5 (1965). (In Russian).

Data obtained with gamma-irradiated (^{60}Co) seeds showed significant interference with lipoxidase activity. Apparently, enzyme activation is partly due to sorption (experiments with dry seeds) but basically to changes in the rate of enzyme synthesis in the first few days of growth. (tr-auth)

42324 PHASE CHANGES OF SOME INDICES OF GROWTH AND METABOLISM INDUCED BY γ IRRADIATION OF NICOTIANA PLANTS. Uzorin, E. K.; Demina, O. K. (Inst. of Biological Physics, Moscow and All-Union Research Inst. of Tobacco, Krasnodar, USSR). Radiobiologiya, 5: 576-9(1965). (In Russian).

Data were obtained on effects of gamma (^{137}Cs) irradiation of Nicotiana seeds. Analysis of both experimental and literature data indicate that the wave-form dependency of irradiation effects and the phase waves in radiobiological effects appear as a general mechanism of radiation action on plants in the study of almost all viability phenomenons. This is true with low doses but not with lethal or sublethal. (tr-auth)

42325 PRE-SOWING IRRADIATION INFLUENCE ON REDOX REGIME AND BIOCHEMISTRY IN THE LEAVES OF HOTHOUSE CUCUMBERS IN RELATION TO SEXUAL DIFFERENTIATION OF PLANTS. Sidorskii, A. G. (Gor'kii State Univ., USSR). Radiobiologiya, 5: 584-8 (1965). (In Russian).

Hothouse cucumber seeds that were gamma irradiated

(^{60}Co) to 1 kR, and then sprouted showed an early increased activity, expressed as a lowered redox potential and increased proteins, carbohydrates, and nucleic acids in the leaves. In the second half of the vegetative period the vital processes returned to normal. (IIC-M.G.)

42326 PECULIARITIES OF RADIOSENSITIZING ACTION OF OXYGEN ON VICIA FABA SEEDLINGS AFTER X IRRADIATION. Mikhelson, V. M. (Inst. of Cytology, Leningrad). Radiobiologiya, 5: 589-92(1965). (In Russian).

The sensitizing effects of oxygen on bean seedlings after irradiation was maximum with oxygen concentrations the same as those in air in the medium. From the criterion of chromosome aberrations, oxygen showed no radiosensitizing effect. (tr-auth)

42327 IRRADIATION INFLUENCE ON THE GROWTH AND DEVELOPMENT OF COTTON PLANTS. Paiziev, P.; Ibragimov, Sh. I.; Kovalchuk, R. I. (Inst. of Genetics and Plant Physiology, Tashkent). Radiobiologiya, 5: 593-5 (1965). (In Russian).

Gamma irradiation at 0.5–1 kR of plants in the 3- or 4-true-leaf and budding stages stimulated growth and accelerated development of the flowering and maturing phases. Irradiation at 0.5–3 kR in the flowering stage contributed to acceleration of ripening. (tr-auth)

42328 γ-IRRADIATION INFLUENCE ON THE CONTENT AND QUALITY OF SPRING WHEAT. Chernyi, I. V. (Inst. of Cytology and Genetics, Novosibirsk, USSR). Radiobiologiya, 5: 602-4(1965). (In Russian).

In experiments with 1 to 10 kR gamma irradiation, the largest number of desirable changes in the wheat gluten occurred with a 5-kR dose. (tr-auth)

42329 γ-IRRADIATION SOURCES FOR BIOLOGICAL EXPERIMENTS. Bibergal, A. V. (Inst. of Biological Physics, Moscow). Radiobiologiya, 5: 612-15(1965). (In Russian).

Four types of gamma irradiation sources are described: ^{60}Co sources for radiobiological experiments; ^{137}Cs sources for seed irradiation; sources for chronic irradiation of plants and animals; and ^{60}Co sources for microbiological and radiation-chemistry studies. (IIC-M.G.)

42330 ON THE CHANGES IN ALKALINE AND ACID PHOSPHATASE SOLUTIONS INDUCED BY ^{60}Co γ IRRADIATION. Nikol'skaya, E. B.; Prokof'eva, E. G. Radiobiologiya, 5: 618-19(1965). (In Russian).

Inactivation of solutions of acid phosphatase by ^{60}Co gamma irradiation was greater than that of alkaline phosphatase of the same specific activity. Inactivation of both types is inversely related to the irradiation rate. Freshly prepared alkaline phosphatase was less radiosensitive than those one or nine days old. (tr-auth)

42331 NEW MAIZE FORMS DEVELOPED BY γ AND NEUTRON IRRADIATION OF POLLEN. Lysikov, V. N. Radiobiologiya, 5: 623-4(1965). (In Russian).

Data obtained over a period of 3 years indicate that ionizing radiation may be used to change inherited characteristics of maize, giving valuable new varieties. (IIC-M.G.)

42332 IONIZING RADIATION INFLUENCE ON THE GROWTH, DEVELOPMENT AND PRODUCTIVITY OF COTTON. Atazhanov, M. A. (Scientific Research Inst. for Selective Cotton Cross-Breeding, Tashkent). Radiobiologiya, 5: 624-6(1965). (In Russian).

Growth, development, and productivity of cotton were increased by ^{60}Co gamma irradiation of the dry seed to 0.5–1.5 kR. The weight of a single boll and the length and yield of fiber were not decreased. Doses >5 kR resulted in morphoses, and semisterile and sterile forms, which indicate early maturity and productivity. With 20 to 30 kR a whole series of early-maturing, highly productive, large-boll formed with different shaped bushes. The productivity activation obtained in M_1 was retained in the M_2 generation. (tr-auth)

42333 α IRRADIATION OF IN VITRO CULTURES OF MAMMALIAN CELLS. Mikhailova, A. A.; Mikhailov, L. M.; Popov, A. S.; Sedamova, E. N. Radiobiologiya, 5: 627-8(1965). (In Russian).

A simple method developed for external alpha irradiation of cells growing in tubes was found satisfactory in preliminary tests. Four $^{239}PuO_2$ (0.9, 0.75, 0.2, and 0.13 μC) sources fastened to stainless steel rods were mounted on special apparatus for insertion in the tubes. Since ^{239}Pu has a half life of 24,110 years, the source strengths are constant. (IIC-M.G.)

42334 REPORT ON THE CENTRAL NERVOUS SYSTEM INFLUENCE ON THE RADIATION SYNDROME. Fridrich, R. (Universitaet, Basel). Radiol. Clin. Biol., 34: 78-82 (1965). (In German).

The survival rate of mice submitted to a total-body irradiation with a subletal dose is raised, when they undergo a biological stress within 48 hours preceding or following irradiation. In case morphine or nembutal is given before the irradiation, this stress effect does not supervene. (auth)

42335 PRIMARY PROCESSES OF IONIZING RADIATION. Minder, W. (Sektion fuer Strahlenschutz des Eidgenoessisches Gesundheitsamtes, Bern). Radiol. Clin. Biol., 34: 83-100(1965). (In German).

A detailed consideration of the primary processes involved in radiation effects in biological systems has, at first, the rather negative result that applications in the explanation of radiation effects is rather questionable. It contributes only in a very rough approximation to the clarification of these complicated problems. Physical experiments on simple systems give quantitative results regarding energy transfers, but give only very incomplete pictures about their quality and the ensuing sequels. Certainly, the primary energy transfer in ionizing radiations does not affect single molecules or atom groups, or even atom bindings, but at first relatively large quantities of matter. The detailed sequels, to be expected in the irradiated system, cannot be predicted from the energy transfers. However, a detailed consideration of the primary radiation chemistry of water, with its particular characteristics, permits rather far reaching and reliable predictions about the relevant sequels regarding other molecular groups. The highly reactive primary products of water are probably capable of all processes, which are made possible by the chemistry of the protoplasm. The final result is certainly a state of higher probability (entropy increase); i.e., basically a disorganization of the extremely highly-organized biological matter. The predominantly oxidizing character of the primary products can be relatively easy understood by the structure of water and its bindings. (tr-auth)

42336 AN EMPIRICAL METHOD OF ESTIMATING PARAMETERS IN A GAMMA DISTRIBUTION. Masuyama, Motosaburo (Tokyo Univ.). Rept. Statist. Appl. Res. Union Japan. Scientists Engrs., 11: 16-17(Dec. 1964).

The method is illustrated by considering the relative frequencies of mitosis found in an ascites tumor or a Yoshida sarcoma after irradiation with x rays of various intensity. (BBB)

42337 THE BIOLOGICAL BASIS OF TISSUE TRANSPLANTATION. Newton, William T. (Washington Univ. School of Medicine, St. Louis). Surg. Clin. North Am., 45: 393-406(Apr. 1965).

The use of ionizing radiations and chemical agents to suppress the homograft reaction is reviewed. 83 references are cited. (BBB)

42338 INFLUENCES ON THE INCIDENCE OF SECONDARY DISEASE IN RADIATION CHIMERAS: THYMECTOMY AND TOLERANCE. Goedbloed, J. F.; Vos, O. (National Defence Research Organization TNO, Rijswijk, Netherlands). Transplantation, 3: 603-9(Sept. 1965).

The influence of thymectomy of host and donor mice on the incidence and time of delayed death in allogeneic x radiation chimeras was investigated. Occurrence of delayed death could not be prevented by thymectomy of the host, but a small prolongation of survival time may have been induced. Death caused by secondary disease could not be differentiated from death caused by wasting due to

thymectomy. Bone marrow derived from thymectomized mice may slightly decrease the incidence of delayed death compared with bone marrow from normal mice. Lymph node suspensions from long-term tolerant chimeras added to normal or tolerant bone marrow did cause a remarkable reduction of secondary disease and delayed death. Lymph node suspensions from thymectomized mice with a nonspecific immunological non-reactivity had no influence on early or delayed death in allogeneic radiation chimeras. (auth)

42339 EFFECTS OF THYMECTOMY AND IRRADIATION ON GRAFT-VERSUS-HOST DISEASE. Field, Edwin O.; Gibbs, John E. (Royal Marsden Hospital, Surrey, Eng.). Transplantation, 3: 634-8(Sept. 1965).

Thymectomy increases the susceptibility of F_1 hybrid rats to graft-versus-host (GVH) disease induced by the i.p. injection of parental strain spleen cells. Susceptibility is further increased by sublethal whole-body x irradiation or by lethal irradiation followed by syngeneic bone marrow transfusion, and is maximal after combined thymectomy and irradiation. There appears thus to be a relationship between the size of the host's lymphoid reserve and susceptibility to GVH disease. There is evidence that susceptibility depends also on the capacity of the host's lymphoid system to regenerate, and this process requires the presence of a thymus. Donor spleen cells, in contrast to bone marrow cells, do not require the presence of a thymus for attaining competence to mount a GVH attack. (auth)

42340 REGENERATION OF THYMUS GRAFTS. I. HISTOLOGICAL AND CYTOLOGICAL ASPECTS. Dukor, P.; Miller, J. F. A. P.; House, Winifred; Allman, Violet (Ciba Ltd., Basel; Royal Cancer Hospital, London). Transplantation, 3: 639-68(Sept. 1965).

The regeneration of thymus tissue in a subcutaneous site or under the renal capsule has been studied histologically and cytologically in mice. The pattern of regeneration, under normal circumstances, was arbitrarily divided into four stages. Necrosis affected all cell types in the center of the implant during the first 24 to 48 hours after grafting and only a peripheral rim of viable tissue containing both epithelial and lymphoid elements was left (stage I). During the next 2 days intense mitotic activity became evident in the lymphoid rim (stage II), and by 5 to 6 days the typical structure of the thymus cortex was restored (stage III). By day 8 normal thymus architecture with characteristic corticomedullary lobules became evident (stage IV). For about the first 2 weeks the cells dividing in the graft were entirely derived from donor cells surviving in the peripheral rim of the original implant. During the 3rd week, host cells were found dividing in the graft and by 21 days the dividing donor cell population had been entirely replaced by host cells. The only significant difference between the regeneration of subcutaneous and subcapsular implants was an earlier invasion by host cells in the former. Pretreatment of the host by thymectomy, γ irradiation, or both, caused some delay in the regeneration pattern of some syngeneic implants. Thymus tissue grafted to normal allogeneic hosts lost the lymphocytes surviving the initial transplantation injury and failed to undergo lymphoid differentiation. Only an epithelial-reticular framework with myelopoietic foci and scattered small darkly staining dense round cells, referred to as small lymphocyte-like cells, were present between the 2nd and 7th day. Between 7 and 11 days the grafts were heavily infiltrated with lymphocytes and histiocyte and they were subsequently rejected. Preirradiation of the host allowed some lymphoid differentiation in some allogeneic grafts but these too were subsequently rejected. Allogeneic thymuses grafted to neonatally thymectomized hosts behaved like syngeneic grafts. Thymus tissue heavily γ irradiated in vitro and implanted into syngeneic hosts was composed of an epithelial-reticular framework totally devoid of lymphoid elements. By day 4, small lymphocyte-like cells appeared in the graft and myelopoietic foci developed. By day 8 large lymphoblast-like cells were seen but mitotic activity and medium and small lymphocytes were not evident until after 11 days. Cytological observations failed to reveal dividing donor-type cells and, after 11 days, host-type cells were in abundance. (auth)

42341 THE EFFECTS OF IONIZING RADIATION ON LYMPHOCYTES (thesis). Neff, Richard Dean. Los Angeles, Univ. of California, 1964. 90p.

The relative radiosensitivities of small, medium, and large lymphocytes were studied by observing lymphocyte size distributions of irradiated and non-irradiated rabbits. Lymphocyte cell culture work was performed to see if one portion of the circulating lymphocytes was more radiosensitive than another. Lymphocyte size distribution curves were obtained from the lymphocytes of circulating rabbit blood by first separating them from the rest of the blood cells and then determining their size distribution using a Coulter Electronic Cell Counter. A complete size spectrum was obtained from only one milliliter of blood by using a 400 channel pulse height analyzer in conjunction with the Coulter Counter so that all lymphocyte sizes were counted simultaneously. The results showed that in vivo irradiation of rabbits produces no change in the relative size distribution of the circulating lymphocytes four hours after exposure to 100 or 200 R. The rate of decrease in lymphocyte count in whole blood irradiated in vitro was much slower than in vivo irradiation. In vitro irradiation of rabbit blood produced no changes in the relative lymphocyte size distribution up to eight hours after irradiation with 1000 R. Of all circulating lymphocytes in the rabbit, 99.9% were under 9 microns in diameter. The most frequent size was 6.6 microns and there were no separate populations of small, medium, and large cells. The relationship of these results to the general area of lymphocyte radiosensitivity is discussed. (Dissertation Abstr.)

42342 IMMUNOLOGIC STUDIES ON LEPTOSPIRA (thesis). Hubbert, William Thornton. Los Angeles, Univ. of California, 1964. 85p.

An investigation was made to determine whether or not resistance to asymptomatic leptospiral infection could be accomplished. An additional aim was to determine the role of circulating antibodies and/or cellular factors in resistance to leptospiral infection. Further, the effect of gamma irradiation on survival, immunogenicity, and virulence of leptospires was studied in order to determine the usefulness of this method of inactivation in these investigations. Infection with Leptospira icterohemorrhagiae AB, LT-351, was studied in 200–300 g male guinea pigs. Leptospires were grown in Stuart's and Ellinghausen's media and those receiving gamma irradiation were exposed to a 1×10^5 Curie ^{60}Co source. Immunization was also attempted by infection and subsequent treatment with penicillin or streptomycin. Determinations of serologic changes after infection were measured by live microscopic agglutinationlysis, serum glutamic oxalacetic transaminase (SGO-T), and paper strip electrophoretic patterns of serum proteins. Leptospires gamma irradiated with 7.14×10^4 R or greater failed to multiply in vitro or in vivo, yet in vitro motility was evident for two to ten days after irradiation, the length of the period decreasing with increasing dosage. Organisms exposed to 3×10^4 to 5.1×10^4 R were not altered in virulence or immunogenicity when inoculated into guinea pigs, even after the sequence of irradiation-inoculation was repeated two more times. Exposure to 1×10^5 or 1×10^6 R did not affect ability of L. icterohemorrhagiae to stimulate agglutinins. Although 2.4×10^3 leptospires gamma irradiated with 1×10^5 R failed to produce clinical symptoms in guinea pigs, there were significant changes in SGO-T levels and serum protein after seven days, suggesting a possible endotoxin-like mechanism involved in the pathogenesis of leptospirosis. Animals treated with streptomycin were not only freed of infection but were found to be solidly resistant to reinfection. However, penicillin therapy was only helpful clinically as the carrier state was not eliminated. In addition, they failed to prevent the establishment of the carrier state. A local tissue response by the host was proposed as the basis for resistance to localized renal infection (the carrier state) and approaches to the practical application of a gamma-irradiated leptospiral vaccine were discussed. (Dissertation Abstr.)

42343 LACK OF INTERACTION OF X-RAY- AND NEUTRON-INDUCED CHROMOSOME BREAKS IN BARLEY

(thesis). Heddle, John Alexander Moodie. Knoxville, Tenn., Univ. of Tennessee, 1964. 59p.

Experiments with combined x-ray and neutron irradiation failed to demonstrate interaction in barley. Although a two-hit dose response curve had previously been reported for barley, (S. Wolff and H. E. Luippold, Nature 179: 208-9(1957)) the x-ray kinetic studies on four year old seeds from the 1959 harvest showed linear kinetics for two-break aberrations suggesting that these seeds were not capable of a two-hit response. Accordingly, both the kinetic studies and the interaction experiments were repeated on seed of the 1963 harvest. These seeds did show a two-hit x-ray dose response curve for two-break aberrations, whereas with neutrons these aberrations increased linearly with dose. The kinetic and interaction experiments support one another in the conclusion that in barley, as in Vicia, there is no quantitatively determinable interaction of neutron breaks with either x-ray breaks or independently induced neutron breaks. Consequently, no minimal value of the rejoining distance could be calculated. The maximal value was estimated to be 0.2 microns while the estimate that best fit the data was 0.02 microns. (Dissertation Abstr.)

42344 EFFECTS OF RADIOACTIVE PHOSPHORUS DECAY ON GENETIC RECOMBINATION IN ESCHERICHIA COLI K-12 (thesis). Krisch, Robert Earle. Philadelphia, Univ. of Pennsylvania, 1964. 169p.

Experiments involving the donor Hfr Hayes were extended to include a considerably larger chromosomal region. In addition genetic and lethal effects were studied in two other donor strains, which exhibit chromosomal transfer in the opposite direction to the Hfr Hayes. Finally, the effects of ^{32}P decay before mating were studied in the recipient cell. For ^{32}P decay before mating in either Hfr Hayes or Hfr Cavalli, the number of recombinants of a given type formed, S(D,x), falls off exponentially with ^{32}P dose, D, and with the genetic distance of the selected male marker from the chromosomal origin, x, i.e., $S/S_0 = e^{-aDx}$. This result was found to be roughly true for nearly half of the chromosome in each of these strains. However, the dose constant appears to differ between them, the Cavalli strain being roughly twice as sensitive to all genetic and lethal effects of ^{32}P decay. The reason for this discrepancy is unknown, but the ratio of genetic to lethal effects appears to be the same for each strain. No definite evidence was found that ^{32}P decay affects the initiation of chromosomal transfer in either of these two donor strains, although a slight effect cannot be ruled out. A genetic analysis of surviving recombinants, in each of the two cases, revealed an approximate dose dependence given by: $S/S_0 = e^{-a(x-x_0)D}$, where now x_0 is the genetic distance from the origin to the selected Hfr character and $x(x > x_0)$ is the distance from the origin to the more distal, unselected character. The results are generally consistent with the current idea that the lethal and genetic effects of incorporated ^{32}P in microorganisms are caused by those random disintegrations of ^{32}P atoms in the DNA molecule which lead to chromosomal breakage. By comparison, ^{32}P decay before mating in the Hfr R1 donor cell gave very anomalous genetic effects. ^{32}P decay in the recipient cell prior to mating with Hfr H caused the appearance of recombinants inheriting various male markers to fall off in such a way that at high doses the survival curves all converge and run parallel to the female viability curve. In addition there was a preferential usage of male genetic information in surviving recombinants. These results suggest that a selective advantage is conferred on those recombinants which receive large portions of the male chromosome during mating. (Dissertation Abstr.)

42345 THE EFFECTS OF IONIZING RADIATION ON THE SARCOSOMES OF HOUSEFLY FLIGHT MUSCLE (thesis). Carney, Gordon Colquhoun. Minneapolis, Univ. of Minnesota, 1964. 98p.

An investigation concerning the examination of sarcosomes which had been exposed to in vivo and in vitro doses of x rays in the range of 50,000 to 200,000 R at 5,000 R per minute is described. Sarcosomes were extracted from the flies within one hour of irradiation and were studied with respect to their morphology, respiration, uptake of inorganic phosphate, and cytochrome c content. Since the wing-beat frequency of flies appears to be dependent, at least partially, on the cytochrome c content of the muscle tissue, one experiment was carried out to measure the frequency before and after the flies were exposed to a dose of 50,000 R. The results indicated a considerable alteration in the physiological properties of the sarcosomes as a result of irradiation in vivo. Irradiated sarcosomes swelled much more than control preparations when suspended in 0.1N KCl solution. Also, a more rapid leakage of cytochrome c was detected in isolated sarcosomes from irradiated flies. On the basis of a limited number of experiments there was evidence that the uptake of inorganic phosphate and the synthesis of ATP (as indicated by the P/O ratio) was impaired in sarcosomes which had been irradiated in vivo at doses above 50,000 R. There was no evidence, however, to indicate that housefly cytochrome c was appreciably altered by in vivo irradiation at doses below 100,000 R. Wing-beat frequency was depressed by about 40% in an experiment in which flies were tested before and immediately after irradiation. No changes in the cytochrome c content of sarcosomes were detected as a result of in vitro irradiation. In conclusion, it may be stated that the radiation effects detected appear to stem from changes in the properties of the sarcosomes. (Dissertation Abstr.)

42346 BIOLOGICAL EFFECTS OF RADIATIONS. Grosch, Daniel S. A Blaisdell Book in the Pure and Applied Sciences. New York, Blaisdell Publishing Co., 1965. 306p. $3.50.

The major principles and problems of radiation biology are presented in an orderly framework from which students can expand subjects of particular interest. After introductory considerations of the radiations and their direct and indirect modes of action, the discussion continues through the cellular to the tissue, organ, and organism level of effect. The effects of natural and artificial radiation on human ecology are considered. Industrial applications of radiation for pest control and food processing are discussed briefly. Each of the 16 chapters is followed by a list of references. (C.H.)

42347 GENETIC EFFECTS OF X-RAYS ON BIOMETRIC TRAITS IN MICE (thesis). Verley, Frank Alwin. Urbana, Ill., Univ. of Illinois, 1964. 106p.

Male and female hybrid mice were exposed to five levels of x irradiation for four consecutive generations. The females were given levels of 0, 10, 20, 30 and 40 R and the males levels of 0, 50, 100, 150, and 200 R. At the time of the single exposure, the animals used as parents of generation one ranged from 60 to 70 days of age. Orthogonal comparisons were used to determine the linear and the quadratic effects of levels of x irradiation on the male parent, the female parent and the various interactions for each trait. Four pairs of second litter offspring were saved from each cell treated identically like the parent of similar sex and used as parents of the next generation. The offspring of the x irradiated male and female mice were observed for evidence of the effects of induced polygenic mutations. The data indicate that litter size is adversely affected by parental x irradiation. There was a linear decrease in the number in the first litter as the level of irradiation of the male parent increased, and the number born in the second litter decreased linearly with the increase in dosage on the female. The adjusted number alive at 38 days of age was not consistently or materially affected by x irradiation of the parents, thus irradiation has not affected livability from birth to 38 days of age. Induced polygenic changes from x irradiation seemed to increase body weight and growth rate. The second litters of treated males were approximately free of these effects. The significant increases in body weight and growth rate as the level of paternal x irradiation increased indicate that there is a genetic basis — probably induced polygenic mutation. (Dissertation Abstr.)

42348 PROBLEMS OF RADIATION GENETICS. Dubinin, N. P. Edinburgh, Oliver and Boyd, 1964. 452p. 5 pounds, 10 shillings.

Translated from Problemy Radiatsionnoi Genetiki by G. H. Beale.

Information is included on: structural, physical, and chemical foundations of heredity; physical basis of the biological effect of radiation; action of ionizing radiation on the heredity of animals, plants, microorganisms, and viruses; effects of uv rays on heredity of plants, animals, microorganisms, and viruses; radiogenetic effect of visible light; radiation genetics of mammals; ionizing radiation and human genetics; and radiation breeding of plants and microorganisms. 886 references are cited. (P.C.H.)

Radiation Effects Therapy and Countermeasures

42349 (NP-15345) COMBINED USE OF CHEMICAL COMPOUNDS AND BONE MARROW IN LETHALLY IRRADIATED MAMMALS. Progress Report. Wakisaka, Gyoichi; Uchino, Haruto; Yamagishi, Morihisa; Hama, Masaharu; Adachi, Kazushige (Kyoto Univ. (Japan). First Dept. of Internal Medicine). [1962]. 10p. Dep. mn.

Dd/s strain mice were used in isologous bone marrow (IBM) transplantation studies and as recipients in homologous bone marrow (HBM) transplantation studies. Na2 strain mice were used as donors in HBM transplantation studies. The sex of donor and recipient mice in each experiment was the same. The modifying effects of S,2-aminoethylisothiourea dihydrobromide (AET) pretreatment alone and of the combined use of AET pretreatment and IBM or HBM transplantation on radiation injury of mice irradiated with various doses of gamma rays were compared with each other. Best results were obtained by the combined use of AET pretreatment and HBM injections. None of the treated mice exposed to 1300 or 1500 R died during the first 21 days after treatment. However, they began to die subsequently with symptoms indicating homologous disease. (auth)

42350 (NP-15346) THE COMBINED USE OF CHEMICAL COMPOUNDS AND BONE MARROW IN LETHALLY IRRADIATED MAMMALS. Progress Report, May 15, 1963-May 14, 1964. Wakisaka, Gyoichi (Kyoto Univ. (Japan). First Dept. of Internal Medicine). Contract 138/R1/RB. 15p. Dep. mn.

Homologous bone marrow (HBM) transplantation from Na2 donor mice pretreated with AET and irradiated with 100 R gamma rays to dd/s recipient mice pretreated with S,2-aminoethylisothiourea dihydrobromide (AET) and irradiated with 1500 R gamma rays gave a good early survival rate, approximately similar to those in isologous bone marrow (IBM) transplantation. These pretreatment, however, did not satisfactorily prevent the recipient mice from developing secondary disease. The fractionated administration of the folic acid antagonist, Methotrexate, immediately after the HBM transplantation resulted in a very good early survival rate, almost equivalent to those in IBM transplantation. This treatment, however, did not satisfactorily suppress the development of the secondary disease. The IBM which was kept in glycerol-Tyrode solution at -75°C as long as 270 days protected well the lethally gamma irradiated mice as well as the fresh IBM transplantation did, when 5 millions of nucleated cells were injected. The HBM preserved as long as 90 days gave somewhat higher 21-day survival rates than those in the fresh HBM transplantation, namely, the frozen and preserved HBM seemed to be taken easily. The HBM which was preserved more than 90 days, however, did not protect the lethally irradiated mice. (auth)

42351 (NP-15347) THE COMBINED USE OF CHEMICAL COMPOUNDS AND BONE MARROW IN LETHALLY IRRADIATED MAMMALS. Final Report, May 15, 1964-May 14, 1965. Wakisaka, Gyoichi (Kyoto Univ. (Japan). First Dept. of Internal Medicine). Contract 138/R2/RB. 19p. Dep. mn.

Methotrexate, a folic acid antagonist, was administered to prevent secondary disease which occurred in lethally irradiated and homologous fetal liver transplanted mice. Feta hemopoietic tissue seemed more sensitive to Methotrexate than the adult hemopoietic tissue as noted by low 14 day survival rate. Therefore, the Methotrexate administration, which has been demonstrated to be beneficial when adult hemopoietic tissue is transplanted, may not be beneficial when fetal hemopoietic tissue is to be transplanted. When the prospective recipient mice were injected intraperitoneally with homologous spleen cells obtained from the prospective donor strain mice one week previously, 700 R irradiated and homologous spleen transplanted mice showed a good early and late survival rate. This effect of pretreatment is strain specific. When pretreatment was done 2 days and 4 weeks previously, 90 day survival rates were low. Similar experiments were performed at 800 R and 900 R irradiation dose. The results varied with different time periods between the pretreatment and irradiation. Anti-donor antiserum at a dose of 0.02 ml gave fairly good early and long-term survival in 700 R irradiated and homologous spleen transplanted mice. The antiserum was administered at the time when homologous spleen cells were transplanted. This beneficial effect of the antiserum was not observed when the dose was increased from 0.02 ml to 0.1 ml. Even with the antiserum dose of 0.02 ml, its beneficial effect was not observed with the irradiation dose of 900 R. (auth)

42352 (SB-511(Suppl.1)) RADIOPROTECTIVE AGENTS. Selective Bibliography of Government Research Reports and Translations. (Clearinghouse for Federal Scientific and Technical Information, Springfield, Va.). Apr. 1965. 8p. CFSTI Free.

Seventy-three reports and translations on radioprotective agents added to the collection of the Clearinghouse for Federal Scientific and Technical Information during the period beginning February 1963 and continuing through April 1965 are listed. A directory of sources is also included. (H.G.D.)

42353 THE BIOLOGICAL EFFECTS OF IONIZING RADIATIONS AT VERY LOW DOSE RATES. Holt, J. A. G. (Inst. of Radiotherapy, Shenton Park, Australia). Australian Dental J., 10: 38-40(Feb. 1965).

An account is given of the basic radiobiological effects of x rays on cells which occur with the doses that would apply to scattered radiation around, and direct radiation in the beam of, a small diagnostic x-ray machine. Such small x-ray exposures are an occupational condition when diagnostic x rays are used and patients undergoing such examinations receive varying doses to the region under review and scattered doses to the rest of the unprotected body. Evidence is accumulating to show that any dose causes damage but at doses of the order of mRem the effect is not predominantly exerted on DNA or DNA-protein complexes, on nucleic acid synthesis, or on any specific site of the cell. Instead irradiated cells show changes which indicate that the network of intracellular membranes within the cell has been partly broken down. The intricate network of phospholipid membranes, which function to keep enzymes and substrates apart, and yet allow oxygen, carbon dioxide and raw materials of low molecular weight to diffuse through, are disrupted by radiation. This membrane disruption is the initial radiation damage, and release of enzymes may follow, with enzyme damage to nucleic acids, proteins, and other constituents. Radiation probably does not directly cause a chromosome break but the enzyme interference is the responsible mechanism and the breaks are not obvious until the next mitosis. Another effect, the alteration in mitotic rate with x rays, appears also to have an independent mechanism, which lies outside DNA synthesis. (TCO)

42354 FURTHER STUDIES ON THE RADIOSENSITIZING ACTION OF SMALL DOSES OF HEMATOPORPHYRIN. Cittadini, C. (Universita, Siena, Italy). Boll. Soc. Ital. Biol. Sper., 41: 363-5(Apr. 15, 1965). (In Italian).

In previous investigations, doses of hematoporphyrin as low as 5 mg/kg, injected intraperitoneally before or after exposure of mice to midlethal radiation doses, had

a radiosensitizing action. Tests were conducted to see if even smaller doses would manifest this action. Thus mice of the NMRI strain, two and one-half months old, were injected with doses of 0.06, 0.18, 0.55, or 1.7 mg/kg of hematoporphyrin 30 min before whole-body irradiation with 200-kv x rays to a total dose of 800 R. The mean survival times were as follows for the five groups: 0.06 mg/kg, 227 hr; 0.18 mg/kg, 184 hr; 0.55 mg/kg, 245 hr; 1.7 mg/kg, 278 hr; controls (saline-injected), 296 hr. Statistical analysis of the results shows that survival time was significantly decreased with the 0.18-mg/kg dose. Thus, hematoporphyrin has a radiosensitizing action at this dose level, as was previously found also at dose levels of 5 and 135 mg/kg. Its possible polyphasic pharmacologic effects, being active at some doses and not at others, are discussed. (BBB)

42355 CHANGE IN THE PROPERDIN LEVEL IN THE BLOOD OF NORMAL AND IRRADIATED ANIMALS UNDER THE INFLUENCE OF MUCOPOLYSACCHARIDE PREPARATION FROM THE CATTLE SPLEEN. Ivanova, N. M.; Shitikova, A. S. (Inst. of Blood Transfusion, Leningrad). Byul. Eksperim. Biol. i Med., 59: No. 6, 42-6(June 1965). (In Russian).

The radioprotective effects of a mucopolysaccharide preparation from the spleen of cattle were studied in x-irradiated mice and rabbits. It was found that the effectiveness of the preparation in increasing survival rates in irradiated animals was due to the stimulation of increased titers of plasma properdin. (J.F.P.)

42356 THE ROLE OF METALS IN THE RADIORESISTANCE OF PROTEINS IN THE SOLID PHASE. Krsmanovic-Simic, Draga; Duchesne, Jules (Universite, Liege). Compt. Rend., 260: 6455-7(June 14, 1965). (In French).

It is shown that the radioresistance of proteins in the solid phase increases considerably when metallic ions are present. This effect is illustrated in the case of ceruloplasmine and hemoglobin. Comparable studies were also made on different complex chelates. (tr-auth)

42357 ULTRASTRUCTURAL ASPECTS OF THE PROTECTION EXERCISED BY CYSTEAMINE AGAINST THE EARLY EFFECT OF X RAYS ON AN EMBRYONIC ORGAN CULTIVATED IN VITRO. Kirrmann, Jean-Michel; Cuminge, Danielle (College de France, Paris; CNRS, Nogent-sur-Marne, France). Compt. Rend., 261: 567-9 (July 12, 1965). (In French).

Cysteamine protected embryonic intestine of chicken cultivated in vitro against the appearance of early cytoplasmic radiolesions observed 2 hrs after irradiation with x rays (7500 and 22,500 R). Protection consisted in a considerable decrease of the number and extent of the ribonucleoprotein condensations in the cytoplasm of irradiated cells. The significant radiolesions induced by x rays were partially suppressed. Cysteamine induced mitochondrial alterations. (J.S.R.)

42358 STUDY ON THE RADIORESTORATION CAPACITY OF THE HETEROLOGOUS AND ISOLOGOUS DESOXYRIBONUCLEIC ACIDS IN THE MOUSE. Vilagines, Roland; Menager, Jacques (Institut Gustave Roussy, Villejuif, France). Compt. Rend., 261: 577-80(July 12, 1965). (In French).

Heterologous and isologous DNA injected intravenously at a dose of 1 mg/ml after irradiation with a lethal or supralethal dose, increased the survival and decreased the weight loss of irradiated mice. From the intestinal tissues of the irradiated animals protected by AET-thiogel, it can be deduced that the restoration process is at the level of the hematopoietic organs. (tr-auth)

42359 ON POTENTIATION OF IONIZING ACTIVITY OF Au-198 INDUCED BY HYDROGEN PEROXIDE: EXPERIMENTAL STUDY. Rossotto, P.; Stancanelli, V.; Georgacopula, P. (Universita, Ferrara, Italy). Minerva Chir., 19: 827-30(Dec. 15, 1964). (In Italian).

The radiosensitizing action on colloidal ^{198}Au of H_2O_2 on ascites tumor cells was studied. Adult Long-Evans rats bearing the Yoshida hepatoma in the ascites form were studied. A 200-μC dose of ^{198}Au was injected intraperitoneally four to five days after inoculation of the tumor cells. In some rats a 0.3% solution of H_2O_2 was also injected intraperitoneally in three doses of 0.8 ml each two days after tumor cell transfer. Respiration and anaerobic and aerobic glycolysis were measured by the Warburg technique in the ascites tumor cells aspirated from the rats. Respiratory quotients for the ascites cells of the four groups of rats (untreated controls, ^{198}Au treated, H_2O_2 treated, $^{198}Au + H_2O_2$ treated) were: $Q_{O_2} = -5.6, -4.3, -5.3, -1.8$. The corresponding values for aerobic glycolysis were: $Q^{O_2}_{CO_2} = +26.4, +21.9, +26.8, +11.3$; and for anaerobic glycolysis: $Q^{N_2}_{CO_2} = +56.4, +39.4, +61.0, +16.7$. The results show that while ^{198}Au had a slight depressant effect on respiratory and glycolytic activities of the cells, and H_2O_2 alone no inhibitory action, the two together significantly inhibited these activities of the tumor cells. Obviously, H_2O_2 alone, at the concentrations used, would not have a toxic effect on the cells. The possible use of H_2O_2 in human tumor therapy to enhance the cancericidal action of γ radiation is proposed. (BBB)

42360 REPORT ON POLYMORPHONUCLEAR LEUKOCYTES AND CONCENTRATION OF ORGANIC POLYCATIONS IN VIVO. Teti, M. (Universita, Messina, Italy; Universita Cattolica, Rome). Minerva Radiol. Fisioterap. Radiobiol., 10: 161-4(May 1965). (In Italian).

Research is reported that suggests prophylactic and therapeutic actions of lysozyme against leukopenia induced by cytostatics, and ionizing radiation. Experimental animals injected with lysozyme became leukocytic due to: a depot of leukocytes as demonstrated by marking circulating cells with acridine orange; hyperplastic bone marrow; and the fact that lysozyme induced a broader spectrum of electromagnetic energy and a better tolerance to the action of mitostatic chemicals. (H.G.D.)

42361 TENTATIVE DATA ON THE LYSOZYME PROTECTIVE EFFECTS IN TELE-PANIRRADIATION. Lupo, M. (Ospedale Maggiore, Novara, Italy). Minerva Radiol. Fisioterap. Radiobiol., 10: 164-5(May 1965). (In Italian).

Skeletal metastases of breast carcinoma were panirradiated with 500 to 700 or 800 R given in daily skin doses ranging from 20 to 25 R. When bone marrow was protected by lysozyme, the average radiosensitivity level was increased. (H.G.D.)

42362 THE INFLUENCE OF CHEMICAL PROTECTIVE DRUGS ON LEUKOPENIA FOLLOWING CHEMIO-RADIO THERAPY. Stoppa, I. M. (Universita, Turin). Minerva Radiol. Fisioterap. Radiobiol., 10: 183-5(May 1965). (In Italian).

Leukopenia induced in rats by pan-irradiation was treated with leukopoiesis-stimulating drugs. Leukocytic action of various drugs was expressed as an increase in lymphocytes or granulocytes. (H.G.D.)

42363 PROTECTION BY ENDOGENOUS ANOXIA AGAINST THE MUTAGENIC AND LETHAL EFFECTS OF X-RAYS IN NEUROSPORA CRASSA. Koelmark, H. G. (Oak Ridge National Lab., Tenn.). Mutation Res., 2: 222-8(June 1965). (ORNL-P-305).

An adenine-less strain of Neurospora crassa was used in studies of endogenous anoxia as protection against the mutagenic (adenine reverse mutations) and lethal effects of x rays. Protection was obtained when conidial suspensions in saline or water were incubated in closed tubes at 20 to 30° before irradiation at 0°. The protective effect of the temperature treatment was cancelled by subsequent oxygen treatment, or prevented by access to air during incubation. Similar protection was obtained by bubbling nitrogen through the suspensions at 0°. The optimal conditions for protection were determined by varying the temperature, time, and conidia concentration during incubation. Using optimal conditions, protection factors in the range 1.6 to 1.9 were found for mutation and lethality effects. Protection against mutation was found only at x-ray doses below 40 kR. From 40 to 50 kR the mutation frequency among survivors was independent of the state of anoxia. At doses exceeding 50 kR, the highest mutation frequency was observed in the anoxic conidia. (auth)

42364 PROTECTION BY 2-MERCAPTOETHYLAMINE AGAINST THE MUTAGENIC AND LETHAL EFFECTS OF X-RAYS IN NEUROSPORA CRASSA. Koelmark, H. G. (Oak Ridge National Lab., Tenn.). Mutation Res., 2: 229-35(June 1965). (ORNL-P-306).

Mercaptoethylamine (MEA) was studied as a protective agent against x-ray-induced mutagenicity (adenine reverse mutations) and lethality. Maximal protection was obtained with concentrations of MEA in the range 0.020 to 0.025M with protection factors 2 to 2.5 for both mutation and lethality. MEA protected to the same extent in water or saline solution, but saline was found to have a protective action of its own, as compared with treatment in water. Protection against mutation was seen only at x-ray doses below approximately 50 kR, whereas at higher doses the highest mutation frequency was found in the MEA-treated series. Increasing the temperature during MEA pretreatment led to an increased maximal protection, but protection by endogenous anoxia then occurred simultaneously. At all temperatures tested, maximal protection was achieved with 0.025M MEA without any toxic or mutagenic effects from the chemical, but the time margin for non-toxic pretreatment became narrower as the temperature was increased. (auth)

42365 ENDOGENOUS OXYGEN CONSUMPTION BY CONIDIA OF NEUROSPORA CRASSA. Koelmark, H. G.; Sutton, H. C. (Univ. of Edinburgh). Mutation Res., 2: 236-41(June 1965).

Measurements of oxygen concentration in suspensions of respiring conidia of Neurospora crassa show that the oxygen concentration during x irradiation as reported previously is certainly below 1 μM and probably considerably lower, and that in sealed air-free suspensions this concentration falls below 0.1 μM after suitable incubation. Anoxic protection against mutation induced by x rays attains the same maximum effect under either of the conditions mentioned. The protection against x-ray-induced mutation in Neurospora afforded by endogenous anoxia, 2-mercaptoethylamine (MEA), and combined use of anoxia and MEA is of the same magnitude. Reasons for this are discussed. (auth)

42366 THE EFFECT ON THE LENGTH OF LIFE IN THE OFFSPRING OF X-IRRADIATED MALE MICE. Froelen, Hakon (Research Inst. of National Defence, Sundyberg, Sweden). Mutation Res., 2: 287-92(June 1965).

One-hundred-sixty-one F_1 males whose fathers had received 500 R of x rays were tested for lifespan, semi-sterility, and prenatal death among the offspring. About half the number of these animals were sons to fathers injected intraperitoneally with 4 mg cysteamine prior to irradiation. A control group of 56 F_1 males was kept. The numbers of semi-sterile males were 9 in the non-protected group, 8 in the group treated with cysteamine, and none in the control group. Among the mice of the irradiated groups which were not semi-sterile the frequency of intra-uterine lethality was about the same as in the control group. No differences in lifespan could be demonstrated between the three groups. (auth)

42367 PHOTORECOVERY FROM THE EFFECTS OF ULTRAVIOLET RADIATION IN THE DEVELOPING BRACON EMBRYO. Amy, Robert L. (Southwestern, Memphis). Radiation Res., 25: 674-83(Aug. 1965).

Ultraviolet inactivation and photoreactivation were studied in ten embryonic stages of Bracon hebetor. At each age, separate dose-hatchability curves for dorsally and ventrally irradiated embryos were obtained. Photoreactivation was not found at those embryonic stages in which cytoplasm alone was irradiated, that is, at less than ¼ hour of age (dorsal surface) or 2 hours (either surface); it was observed when nuclear materials were probably the most important uv chromophores, that is, at less than ¼ hour of age (ventral surface) and in 3-hour and all older embryos (both surfaces). Dose-reduction factors for 50% hatchability averaged 0.33 ± 0.05 among embryos that exhibited photoreactivation up to 24 hours of age, whereas at 25 hours they were somewhat higher; there was good agreement between surfaces at any given age. In all instances dose-reduction factors were constant. This is interpreted to mean that nucleic acids and/or nucleoproteins, the most likely chromophores associated with photorecovery processes, are involved morphogenetically in a constant manner. Such constancy suggests, but does not prove, that the chromophore concerned with uv inactivation does not vary with developmental age. No correlation was observed between the varying uv sensitivity of the developing embryo and the occurrence or magnitude of photoreactivation. (auth)

42368 RADIATION GLOMERULOSCLEROSIS AND OTHER LATE EFFECTS: INFLUENCE OF RADIOLOGICAL FACTORS AND AET. Cosgrove, G. E. (Oak Ridge National Lab., Tenn.); Upton, A. C.; Smith, L. H.; Dent, J. N. Radiation Res., 25: 725-35(Aug. 1965).

Mice were exposed to 300 to 1200 R of whole-body or partial-body x irradiation at 10 weeks or 1 year of age. Some groups received AET before irradiation. The incidence of glomerulosclerosis increased with radiation dose, from less than 4% in controls to more than 90% after exposure of the kidney to 1200 R. Administration of AET before irradiation slightly reduced the induction of glomerulosclerosis. Shielding the kidney prevented induction of the disease. Exposure of the kidney region alone was as effective in inducing the disease as whole-body irradiation. At a given radiation exposure level, glomerulosclerosis appeared in higher incidence in animals irradiated at 10 weeks of age than in those irradiated at 1 year of age, presumably because the latter failed to survive long enough in adequate numbers to develop as high an incidence of the disease. Longevity was reduced by whole-body irradiation or by lumbar area exposures of 1200 R given at 10 weeks of age but not by such radiation given at 1 year. The incidence of thymic lymphoma was increased by whole-body exposure and was dose-dependent. Exposure of both ovaries resulted in a marked increase in ovarian tumor incidence when the exposure was given at 10 weeks of age and a lesser increase with exposures at 1 year. Graying of fur occurred in exposed areas in proportion to dose. No significant differences in the induction of ovarian tumor or graying of the fur were noted at a given exposure level when animals were treated with AET prior to irradiation. (auth)

42369 FACTORS OF RADIOSENSITIVITY OF PLANTS TO γ IRRADIATION. Grodzinskii, D. M.; Bidzilya, N. I.; Golikova, O. P. (Inst. of Plant Physiology, Kiev). Radiobiolgiya, 5: 596-601(1965). (In Russian).

The endosperm from gamma-irradiated (60 kR) wheat seeds did not affect the growth of nonirradiated seedlings. The radiosensitivity of various seeds was clover < onion < quack grass, radish < tomato, flax, as shown by the strength of electron paramagnetic resonance signals 2 days after 10 Mrad gamma irradiation. A high radiation-protection effect was shown by Ca, Na, Mg, Sr, Bi, Y, Cs, Rb, and K when applied to cucumber seeds prior to or immediately after 25–30 kR gamma irradiation but none when applied later. Iron and Mn had a strong effect when applied later. Addition of iron to irradiated cysteine increased the EPR signal. (IIC-M.G.)

42370 INHIBITION BY AUTOLYSIS BY SUBSTANCES CAPABLE OF RADICAL POLYMERIZATION. Arkhipov, A. S.; Kozlov, Yu. P. (Moscow State Univ.). Radiobiologiya, 5: 616-17(1965). (In Russian).

X-ray doses of 5000 R shortly after irradiation of white rats caused a significant increase in liver tissue autolysis. This was shown by changes in the total amino acid content in the tissue and nature of the inclusion of glycine–^{14}C in the liver protein. Acrylamide and vinylpyrrolidine, which are capable of radical polymerization, had a depressant action on the autolysis reaction. (tr-auth)

42371 CYSTAMINE INFLUENCE ON PANCYTOPENITIC SYNDROME IN ACUTE RADIATION IN DOGS. Moszhukhin, A. S.; Makhalova, O. K.; Sokolova, E. N. Radiobiologiya, 5: 621-3(1965). (In Russian).

Administration of cystamine to dogs before x irradiation decreased the usual drop in blood leukocyte and erythrocyte counts during the first few days after irradiation and during

the illness. Thrombocyte counts were affected somewhat less. (IIC-M.G.)

42372 THE TREATMENT OF IRRADIATION SICKNESS IN THE DOG WITH AUTOLOGOUS AND HOMOLOGOUS BONE MARROW. Jordan, George L. Jr.; Cunningham, Daniel S.; Travis, Lewis; Barton, Harry L.; Collins, Vincent P. (Baylor Univ., Houston, Tex.). Surg. Gynecol. Obstet., 113: 591-7(Nov. 1961).

To gain further experience with transplantation of autologous and homologous marrow in dogs, 122 animals were irradiated with surface doses of 400, 500, 600, 700, 850, and 1000 R with a 2000-kv Van de Graaff machine. Irradiation was administered as a single dose through 2 ports, one-half of the dose to the right and one-half to the left side. Some animals were treated with autologous bone marrow after irradiation exposure. Two of the four control dogs exposed to 400 R survived, while only one of the four dogs exposed to 500 R survived. None of the four control dogs exposed to 600 R or of the 18 exposed to 700 R survived. Seven of the 14 animals treated with bone marrow after 700 R survived for more than a month, and the hematologic alterations returned to normal. Only two of the eight dogs treated after exposure to 850 R survived. None of the six dogs survived exposure to 1000 R. In other experiments homologous marrow was injected in dogs irradiated with the 200-kv x rays. One of the four control dogs given 350 R of whole body irradiation with the 200-kv x rays survived. No animal receiving a higher dose survived. The animals exposed to 400 R survived from 8 to 12 days, with an average survival of 9 days. Animals exposed to greater amounts died in shorter periods, no animal living beyond 10 days. None of the animals treated with homologous marrow survived for a period significantly longer than the controls. These results demonstrated that autologous marrow offers some protection against the lethal effect of irradiation. However, homologous transplantation of marrow failed to protect any animal against the effects of irradiation irrespective of techniques employed. (BBB)

42373 THE RADIATION-PROTECTIVE ACTION AND THE IRRADIATION-THERAPEUTIC EFFECTS OF FREUND'S ADJUVANT IN LETHAL IRRADIATION OF THE ENTIRE BODY WITH X-RAYS. Gabler, E.; Stoeckl, W. (Tieraerztliche Hochschule, Vienna). Z. Immunitaets-Allergieforsch., 128: 333-41(1965). (In German).

When complete Freund's adjuvant, an emulsion of heat-killed myco bacterium, was given subcutaneously after lethal irradiation of the whole-body it produced a survival rate of 30% in white mice, of 25% in albino rats, of 20% in guinea pigs. If it is given 3 hours prior to the lethal irradiation, a survival rate of 20% is achieved in white mice, albino rats and guinea pigs. When guinea-pigs are sensitized with 0.1 ml of Freund's adjuvant and 0.1 ml are reinjected after 16 days, a survival rate of 66% can be achieved provided the reinjection is given approximately 20 minutes following the lethal whole body irradiation. The possible mode of action is discussed. (tr-auth)

Radiation Hazards and Protection

See also HEALTH AND SAFETY.

42374 A CASE OF SKIN CONTAMINATION WITH ^{14}C LABELLED CHLOROACETIC ACID. Dancer, G. H. (Radiochemical Centre, Amersham, Eng.); Morgan, A.; Hutchinson, W. P. Health Phys., 11: 1055-8(Oct. 1965). (AERE-M-1190).

Measurements made after a worker accidentally spilled hot chloroacetic acid labelled with carbon-14 on his fingers are described in this paper. These included determination of skin contamination and also of carbon-14 in breath and urine samples. The dose to skin is estimated to have been between 200 and 1600 rad, depending on the depth of penetration. No sign of skin erythema or other radiation damage was observed and the wound healed in the normal time. The metabolism of chloroacetic acid is discussed and the determination of carbon-14 in urine by liquid scintillation counting is suggested as a valuable supplement to breath measurements where people are exposed to internal contamination with carbon-14 labeled compounds. (auth)

42375 HYGIENIC ASPECTS OF ROUTINE OPERATION WITH IONIZING RADIATION. Spaander, J. (Rijks Instituut voor de Volksgezondheid, Utrecht). Ned. Tijdschr. Geneesk., 108: 1986-91(Oct. 17, 1964). (In Dutch).

The physical-biological background of radiation is given, with reference to the relative effects in viruses, cells, and bacteria compared to macroscopic objects and to the atom. General concepts of the primary processes in radiation are considered. Radiation hygiene aspects of radiotherapy are discussed in terms of treatments with α and β radiation and those with γ radiation. The quantity of radioactive materials and their types used in various regions of the world were estimated. In Holland in the middle of 1964 there were 38 medical centers using radioisotopes; these are mapped and outlined according to use. Two centers use isotopes for therapeutic purposes, 15 for both therapeutic and diagnostic, and 21 only for diagnostic purposes. Twenty-six other centers have ^{60}Co and Ra sources; a few use other isotopes, particularly ^{131}I, ^{198}Au, and ^{32}P. Suggestions for transportation of radioisotopes and patient safety in their use are given. The use of isotopes in Holland is compared with that in the United Kingdom, Canada, Israel, and Australia, and comparisons on the genetically significant dose are given. It is recommended that physicians using such materials take precautions not to endanger public health in their application and disposal. (BBB)

42376 MEASUREMENT OF ^{226}Ra AND ^{210}Po IN TEETH AND BONE OF AMERICAN SUBJECTS WITH NO HISTORY OF OCCUPATIONAL EXPOSURE. Tanooka, Hiroshi (Japan Atomic Energy Research Inst., Tokyo). Radioisotopes (Tokyo), 14: 309-14(July 1965). (In Japanese).

The amount of ^{226}Ra and ^{210}Po in teeth and bone of American subjects having no history of the occupational exposure was measured and expressed by the unit curie/g·Ca for comparison with the expression curie/g·ash. ^{226}Ra was measured by deemanating ^{222}Rn gas from the sample solution and counting by the ZnS-coated scintillation counter, ^{210}Po was measured by plating on a silver foil and counting by a gas-flow counter, and the calcium content was measured by the flame photometer. A larger amount of both nuclides was found in bone than in teeth and also a greater amount of ^{210}Po (consequently ^{210}Pb) was found in both bone and teeth than the amount expected as a daughter of the ^{226}Ra content. (auth)

Radiotherapy and Radiodiagnosis

Refer also to abstracts 42577, 42727, and 42741.

42377 (NYO-3481-1) USE OF IODINE-125 FOR INTRA-ORAL X-RADIOGRAPHY. Soeremark, Rune (Harvard School of Dental Medicine, Boston, Mass.). 1964. Contract AT(3481)-1. 20p. (CONF-641017-10). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Symposium on Low Energy X and Gamma Sources and Applications, Chicago.

The use of ^{125}I as an x-ray source for dental radiography is described. It is pointed out that ^{125}I can be concentrated to a very small focus and thus it is possible to have a rather short distance between the source and object. Exposure time may be reduced without impairing the quality of the roentgenograms and various types of exchangeable collimators may be used in order to diminish unsuitable radiation. Ordinary intraoral roentgenograms can easily be taken by means of a simple film-source holder fixed to the teeth. For panoramic roentgenograms the unit is small enough to be placed intraorally in a holder and collimator fixed to the teeth. The collimator is so constructed that an exposure of the upper and/or lower jaws may be made on the extra-orally placed film. As opposed to the conventional dental x-ray apparatus, the ^{125}I unit requires a minimum of space, is easy to transport, and is entirely independent of electrical power. A fast and high resolution Polaroid film eliminates the need for dark room facilities.

Exposure data relating to various human objects are included. (C.H.)

42378 (TID-22127) CLINICAL EVALUATION OF ^{137}Cs TELETHERAPY. Technical Progress Report. (Michigan Univ., Ann Arbor). [1965]. Contract AT(11-1)-245. 5p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Design features of a ^{137}Cs teletherapy unit are discussed briefly. The unit was used in the treatment of a variety of neoplasms in 783 patients. (C. H.)

42379 MODIFICATIONS IN CLEARANCES IN ^{198}Au AND B.S.P. IN ALIMENTARY ALLERGIES. Gauthier, A. P.; Sarles, H.; Camatte, R. (Institut des Isotopes, Marseille). Acta Allergol., 19: 111-20(1964). (In French).

Gold-198, in conjunction with bromsulfophthalein (BSP) can be used to determine the effect of alimentary allergies upon hepatic function. Twenty allergic subjects were fasted, and eight were subjected to allergy tests, four by an alimentary allergen two hr before testing and four by tuberculin 48 hr before testing. The untreated allergic subjects showed no vascular modifications from the normal, as indicated by no significant change in the clearance of ^{198}Au. But, there did exist an insufficiency of liver parenchymatous cells, as indicated by a reduction in the clearance of BSP. The normal BSP clearance value (K) was reduced from the normal 12.4 to 11.0. The K for ^{198}Au increased from 15.5 to 15.9. The subjects exposed to an alimentary allergen showed a reduction of K for ^{198}Au from 15.5 to a minimum of 10.6. The elimination of BSP, on the other hand, increased from 12.4 to a maximum of 16.5. The subjects subjected to tuberculin showed the inverse, i.e., an increase in the clearance value of ^{198}Au to a maximum of 18.2 and a decrease in the clearance value of BSP to a minimum of 9.9. These figures, however, are not considered conclusive, since the average changes, 15.6 for the ^{198}Au and 12.7 for the BSP, were statistically insignificant. (BBB)

42380 COMPARATIVE VALUE OF ADRENAL SURGERY AND HYPOPHYSIOLYSIS BY ^{90}Y IN THE TREATMENT OF ADVANCED BREAST CANCER IN WOMEN. Dargent, M.; Mayer, M.; Colon, J.; Dutou, L.; Pommatau, E.; Poulain, S.; Haour, P. (Centre Leon Berard, Lyon). Acta Chir. Belg., 63: 482-515(May 1964). (In French).

Cases of advanced breast cancer, having undergone bilateral adrenalectomy (131 cases), adrenalsplenic transplantation (117), or hypophysiolysis (84) were compared to determine the advantages of treatment with ^{90}Y. Adrenal surgery and transplantation both resulted in considerable deterioration of the patient's condition during the first 18 months, but there were some survivors even 5 yr after double adrenalectomy. These results were determined in part by the location of the systemic lesions, the duration of their development, the age of the patient, and the date of the previous ovariectomy. The results of the treatment of soft tissue metastases by hypophysiolysis were sometimes spectacular. It was found, however, that transplantation was the most efficient method for treating metastases to the bone. The duration of tumor dissemination had little effect on the results of hypophysiolysis. The date of the previous ovariectomy had no influence. The technique of destruction of the pituitary by ^{90}Y implantation, its indications and contraindications, selection of patients, operative mortality, secondary complications, clinical results, and effects on endocrine function were outlined. Grains of ^{90}Y were implanted stereotactically in the sella turcica. Operative mortality was essentially nil, only one patient died as an immediate result of ^{90}Y implantation. Severe secondary complications following radiohypophysiolysis included 21 cases of leakage of cerebrospinal fluid (appearing a month or more later) with four developing meningitis, three cases of ocular disorders, and 47 cases of diabetes insipidus. (TCO)

42381 RADIOTHERAPY IN CANCER OF THE CERVIX. Unnerus, C.-E.; Rekonen, A.; Vauramo, E.; Turtola, V.; Kivinitty, K. (Univ. Central Hospital, Helsinki). Acta Obstet. Gynecol. Scand., 43: Suppl. 3, 30p.(1964).

Extensive physical data on the use of 250-kv x rays to treat cancer of the uterine cervix and corpus are reported, with particular respect to dose estimation and measurement. Tissue displacement during therapy was taken into consideration as well as anatomic asymmetries, and the total doses decided on the basis of application of doses individually to the right and the left sides. Statistical data of the doses received by patients by this method are given in addition to estimates of the skin, bone marrow, and volume doses. Special attention was paid to the control of doses to the bladder, intestine, and ureters. Isodose measurements for Ra applicators and x-ray therapy are provided in appendices. The effect of the RBE on the doses was examined in relation to the applicator isodoses. Dose planning, with reference to isodose data, is described in detail. In x-ray therapy the usual skin dose was 30 to 40% of the depth dose. The skin dose thus totaled about 2500 R. Statistical analysis showed that 70% of patients received a dose that was 70 to 130% of the intended tumor dose. The corresponding range in the parametrial region was 75 to 125%. Phantom dosimetry was performed, using human bones embedded in Mix-D to simulate the pelvis, for 250-kv x rays, Ra and ^{60}Co internal applicators, and Betatron radiation. Isodose charts are presented. (TCO)

42382 COMBINED TREATMENT OF DISSEMINATED OVARIAN CARCINOMA WITH COBALT TELETHERAPY AND CYTOSTATICS (CHLORAMBUCIL). Papavasiliou, C.; Kostouros, D. (Univ. of Athens). Am. J. Obstet. Gynecol., 89: 691-3(July 1, 1964).

Ten patients with advanced ovarian carcinoma were treated by ^{60}Co and 10 others by ^{60}Co γ radiation and chlorambucil (per os) concomitantly. Telecobalt therapy was given through four anterior portals covering the whole abdomen as homogeneously as possible from the xiphoid to the symphysis pubic. Chlorambucil was administered throughout the whole irradiation period in a dose of 0.1 to 0.2 mg/kg per day. Better results were obtained in patients receiving the combined treatment (Group II) than in those receiving only radiation (Group I), in terms of early response to the treatment and not survival time. Patients of Group II presented a more prompt and steady decrease in the size of the masses than patients of Group I, which was accompanied by subjective improvement. In no case was a complete disappearance of the masses obtained. Complications arising from both methods are discussed. It is concluded that chlorambucil sensitizes the normal tissues and tumors as well to the action of ionizing radiation. (TCO)

42383 CARCINOMA OF THE CERVIX: RESULTS OF TREATMENT BY RADIATION ALONE AND BY COMBINED RADIATION AND SURGICAL THERAPY IN 335 PATIENTS. Crawford, Edward J. Jr.; Robinson, L. S.; Vaught, J. Am. J. Obstet. Gynecol., 91: 480-5(Feb. 15, 1965).

Results of treating Stage I and Stage II cervical carcinomas either by radiation alone or in combination with surgery are reported. Radioinduced complications occurring in 23% of the patients are described. In general, six weeks after external irradiation and implantation of radium, patients under 60 years of age were treated by radical hysterectomy. Of the patients treated surgically, 87.5% lived at least 3 yrs, and 81% survived for 5 yrs. Of the patients treated with radiation alone, three and five year survival rates were 52% and 45% respectively. It is concluded that the incidence of complications is increased minimally, if at all, by use of radical surgical procedures after radiation, and in fact, in may ways this method of treatment lowers the incidence of more severe complications. (TCO)

42384 MEDICAL RADIATION: PERSPECTIVES IN RISKS AND REWARDS. Chamberlain, Richard H. (Univ. of Pennsylvania, Philadelphia). Am. J. Public Health, 55: 720-30(May 1965).

The hazards from medical uses of radiation are reviewed. It is pointed out that the radiation doses used in diagnosis are so small that no deleterious effects are produced if available precautions are observed. In radiation therapy the goal is to deliver homogeneous radiation throughout a desired limited volume of the body and to give as little ra-

diation as possible to all other portions. It is pointed out that this ideal can never be achieved in practice, for there is always a gradient of dose within the desired volume and always some scatter and unwanted inclusions of other portions of the body. The physician is comfronted with the decision as to the risks and benefits to be derived from the radiation exposure. (C.H.)

42385 SIMULTANEOUS HIGH-ENERGY IRRADIATION AND CHEMOTHERAPY. Lawton, R. L.; Latourette, H. B.; Collier, R. G. (Univ. of Iowa, Iowa City). Arch. Surg., 91: 155-60(July 1965).

The combined use of ^{60}Co γ radiation and regional perfusion with cytostatic agents is described in 56 cases with far-advanced primary tumors of the head and neck. Doses and technics used, clinical results, and complications are reported. Irradiation was usually administered in 200-R doses daily for four to six weeks. The average tumor dose was near the 6000 R level. Intra-arterial infusion was initiated simultaneously with the radiation therapy and continued for the first two weeks of combined treatment. Various techniques were used to deliver cancer chemotherapeutic drugs to tumors through their arterial supply. Most involved direct placement of catheters into arterial systems. Initially a bedside finger pump was used to deliver the drug into the arterial system, but it was cumbersome to disconnect the patient from this device each time he was sent to the ^{60}Co therapy unit. Instead of the bulky bedside unit, a small battery-operated pump was later used which could be taped to the patient's skin and allow ambulation. One of the most serious complications was severe bone marrow depression. With methotrexate-citrovorem factor as a combination this type of toxicity was seen on several occasions, but the use of fluorouracil in a 5 mg/kg per 24-hr dosage was not associated with serious systemic complications. Severe local reactions in skin and mucous membrane were indistinguishable from second and third degree burns. Combined intra-arterial infusion and irradiation resulted in a more rapid decrease in the size of cancers than would be anticipated using either modality alone. The initial reaction from the infusion appears in four or five days and becomes maximal by the end of the second week. Then the patient has the most serious, and uncomfortable local reaction. Even though the irradiation treatment is continued for another two to four weeks, there is a gradual subsidence in the marked reaction noted at the completion of the second week of infusion. Where direct observation was possible, the tumor in many instances was seen to regress completely at the termination of radiation therapy. The complication rate did not seem to be any higher than would be anticipated with either modality alone. (BBB)

42386 THE TREATMENT OF ACTINIC PROCTITIS WITH PHENYLBUTAZONE SUPPOSITORIES. Klauber, E. (Oncological Research Inst., Bratislava). Bratislav. Lekarske Listy, 44: 221-3(Aug. 31, 1964). (In Czech).

In eight cases of uterine cervical carcinoma the therapeutic effect of phenylbutazone suppositories on radioproctitis, developing after radium therapy, was followed. In all patients subjective improvement was observed after the use of phenylbutazone suppositories. In hospitalized patients this treatment is recommended in cases where the Held solution (an emollient) has proved unsatisfactory or in patients in whom the radioproctitis has developed after they have been discharged from hospital care. In phenylbutazone treatment, attention should be paid to its known contraindications, and blood leukocytes should be checked during the treatment, and the treatment stopped at any sign of leukopenia. The phenylbutazone suppositories contain 200 mg of the drug. In trials of phenylbutazone with and without vegetable oil emollients and in combination with triamcinoline (4 mg), phenylbutazone's effect was not potentiated by these substances. (BBB)

42387 RADIATION BIOLOGY PERTINENT TO DENTISTRY. English, James A. (State Univ. of New York, Buffalo). J. Am. Dental Assoc., 70: 1442-9(June 1965).

This review of the last three years' of the literature (111 references) covers advances in dental radiation research. Reports on the distribution of radioisotopes in the teeth and jaws of various animals are summarized. The hard structure of teeth provides a convenient record for measurements of interest to the radiobiologist. For example, the deciduous teeth of children offer a reliable means for monitoring the levels of ^{90}Sr from fallout. The total body burden of a person contaminated with Ra can be estimated from the Ra content of a single tooth. Reports that deal with technics, methods, and results of treating malignancies of the oral region with ionizing radiation are surveyed. They show that osteoradionecrosis is a calculated risk in using oral radiotherapy; it is more prevalent when teeth remain in the jaws, and nearly all oral surgeons recommend removing any teeth that lie in the field of radiation. The pathologic or biological effects of ionizing radiation in the oral region are described. Many investigators studying radiation phenomena related to the head regions of experimental animals have observed that some animals die about nine days after local exposure of the head region to doses of 1500 to 2500 R (LD_{50} is 1700 R). This amount of radiation to a local region the size of the head would not ordinarily be expected to cause death. This has been referred to as oral radiation death, and attributed to special sensitivity of the lower jaw and tongue. The cause of death may be failure to eat and drink. Another area of radiobiological research reviewed is the effect of radiation on the development of the teeth and jaws. A discussion of the biological changes to be expected from diagnostic radiation is also given, and it is concluded that with proper collimation, filtration and use of fast film, dental radiography is a safe and proper procedure. The dentist is more prone to be overexposed than the patient but, with standard safety precautions, he is in no danger. Collimators to further reduce the area exposed in dental radiography have been developed. Most writers concluded that reasonably safe procedures are being carried out, even though some improvement is possible in certain instances. Since so many x ray films are exposed in dental radiography, it has been pointed out that small reductions per patient are worthwhile insofar as total exposure to the population is concerned. (BBB)

42388 TREATMENT OF LEUKEMIA BY EXTRACORPOREAL IRRADIATION. Thomas, E. D.; Epstein, R. B.; Eschbach, J. W. Jr.; Prager, D.; Buckner, C. D.; Marsaglia, G. (Univ. of Washington School of Medicine, Seattle). New Engl. J. Med., 273: 6-12(July 1, 1965).

A method of extracorporeal irradiation applicable to man is described, and five cases treated with it are presented. The volume of blood in the irradiation field ranged from 1.8 to 7.6 ml. Three x-ray sources were used, giving 2100 to 6000 R/min. A reduction in the level of circulating leukemic lymphocytes was achieved in all cases. Serial white-cell counts during irradiation, and for several hours afterward, showed no significant decline. Lack of an immediate effect of irradiation may be attributed to a relatively slow destruction of cells after lethal irradiation or to rapid replacement from a large tissue pool of leukemic cells. The eventual decline in cell count indicated that the cells were being destroyed by the irradiation. Clinical observations are presented for each of the patients treated with the method. (H.G.D.)

42389 CLINICAL AND HISTOLOGICAL STUDIES ON ^{60}Co IRRADIATION THERAPY IN CARCINOMA OF THE UTERINE CERVIX. Kijima, Osamu (Kumamoto Univ., Japan). Nippon Sanka Fujinka Gakkai Zasshi, 13: 575-84(May 1961). (In Japanese).

Effects of ^{60}Co γ irradiation on cervical cancer of uterus as seen clinically and histologically are reported. Irradiation was given by two methods: teleradiation and transvaginal contact irradiation. Tumor dose was in the range of 2750 to 6680 R in the first method and 3054 to 4769 R in the latter. Macroscopic appearance of the primary lesions were improved markedly in nine out of 20 cases which received the former type of radiation, slightly in eight, and not in others. With the second technique of irradiation such improvement was seen markedly in 13 to 20, slightly in six, and not in one case. Histological examination in these

40 treated cases revealed that cancer tissues in the primary lesions were subject to degenerative changes before improvement was clinically observed. Histochemical study showed that glycogen content of cancer cells increased, DNA decreased markedly, and RNA decreased slightly. Ninety-four patients were treated by a combination of the two radiation methods. The radiation intensity was 6000 to 8000 R at point A and 3500 to 5000 R at point B. Pelvic examination in these cases after completion of radiation therapy showed the following results; the primary lesions were improved markedly in 74, slightly in 18, and not at all in two. Parametrial infiltration by cancer was relieved in 52 of 81 cases which had been clinically found to have infiltration in their parametrial tissues before treatment, not relieved in 27, and recurrent in two cases. (BBB)

42390 A HYDRAULIC PRESS FOR PRODUCTION OF PROTECTIVE LEAD SHIELDS USED IN X-RAY THERAPY. Szymczyk, Wislawa; Drejak, Zdzislaw (Inst. of Oncology, Krakow). Nowotwory, 14: 193-6(1964).

The press, which is diagramed and illustrated, can be used to form 1- to 2-mm thick lead sheets on plaster molds. Pressures of 10 to 20 atm are possible. The resulting shields can be used to protect specific body parts during irradiation of tumors. (BBB)

42391 INVESTIGATIONS ON THE DISTRIBUTION OF X-RAY DOSE IN PATIENTS WITH CARCINOMA OF THE LARYNX TREATED BY RADIATIONS. Skolyszewski, Jan (Inst. of Oncology, Krakow). Nowotwory, 14: 353-5(Oct.-Dec. 1964). (In Polish).

X-ray doses were measured on a neck phantom under conditions of two treatment techniques for laryngeal carcinoma presently used at the Institute of Oncology at Kracow. Both methods were evaluated. (H.G.D.)

42392 DISTRIBUTION OF THE DEPTH DOSE AND EXPOSURE OF RECTUM AND BLADDER IN X-RAY TREATMENT OF THE CARCINOMA OF THE CERVIX OF THE UTERUS. Hliniak, Andrzej; Darlewski, Jerzy; Hliniak, Irena; Lobodziec, Wlodzimierz; Wojcieszek, Zbigniew; Petryna, Alicja (Inst. of Oncology, Gliwice, Poland). Nowotwory, 14: 417-21(Oct.-Dec. 1964). (In Polish).

Methods of x-ray treatment of patients with cervical carcinoma at the Institute of Oncology in Giliwice are discussed. Dose curves were prepared, and dose measurements were made of the rectum, bladder, and vagina. Small differences in the exposure of these tissues did not interfere with the irradiation method used since each case was treated individually. Osseous tissue did not decrease depth dose significantly when fields used in normal clinical procedures were used. (H.G.D.)

42393 LATE POSTRADIATION INJURY OF THE LARYNX IN RELATION TO THE INTENSITY OF TOPICAL REACTION DURING X-RAY TREATMENT OF THE CARCINOMA OF LARYNX AND LOWER PHARYNX. Kusnierczyk, Waclaw; Betkowski, Andrzej; Kwiatkowska, Anna; Lepkowska, Halina; Swiatnicka, Jolanta (Kliniki ORL Slaskiej AM, Zabrzu, Poland; Inst. of Oncology, Gliwice, Poland). Nowotwory, 15: 173-9(Apr.-June 1965). (In Polish).

Three hundred thirty five cases of carcinoma of the larynx and lower pharynx treated by conventional x-ray therapy are analyzed. Postradiation reactions in larynx during treatment are classified into three stages according to intensity of reaction. Cases of laryngeal carcinoma are classified into clinical stages according to international classification (TNM). Analysis indicates that excessive reaction in larynx and lower pharynx (grade III) during treatment influences unfavorably the percentage of 3.5 and 10 years survivals of patients and the frequency of late postradiation injuries of the larynx particularly in patients in stage III of clinically advanced carcinoma of the larynx and lower pharynx. It is suggested that the early reaction in larynx and lower pharynx to the stage I and II be restricted by adequate planning of radiation treatment. (auth)

42394 RADIOLOGICAL APPEARANCES FOLLOWING RADIATION TREATMENT OF GIANT CELL TUMOR OF BONE. Kopera, Zygmunt; Guzecki, Andrzej (Inst. of Oncology, Krakow). Nowotwory, 15: 181-5(Apr.-June 1965). (In Polish).

Radiologic examination following radiotherapy of giant cell tumors in bones showed that similar lesions were present in patients studied at the same post-irradiation intervals. Bone changes were demonstrated in serial films. The importance of radiological follow-up examinations is stressed. (H.G.D.)

42395 THE APPLICATION OF ISODOSE DISTRIBUTION IN THE PLANNING OF TREATMENT. Gajl, Danuta; Gwiazdowski, Bogdan; Wasilewski, Michal (Inst. of Oncology, Warsaw). Nowotwory, 15: 193-6(Apr.-June 1965). (In Polish).

The planning of multiple method radiotherapy in Institute of Oncology in Warsaw is described. A method for deriving composite isodose curves based on successive addition of single field distributions is discussed. An example of planning and molding is shown. Two methods of final isodose determination are presented. (auth)

42396 PRELIMINARY EXPERIMENT ON SCINTIGRAPHIC SCANNING OF SKELETONS BY RADIO-STRONTIUM (^{85}Sr). Cantarano, G.; Centi Colella, A.; Pigorini, F. (Universita, Rome). Nuntius Radiol., 30: 1258-78(Dec. 1964). (In Italian).

Starting from the knowledge on the behavior of the bone-seeking radioisotopes which are concentrated in the skeleton and, particularly, in the bone lesions, the authors point out the scientific background and the purpose of the researches they are carrying out with regard to the diagnostic possibilities of scanning the skeleton with ^{85}Sr using a high-efficiency scanner. This apparatus is built for detecting very energetic radioisotopes. Radioisotope techniques applied in these researches, particularly that for morphologic studies of the bone tissue, are described; preliminary results and some observations are briefly presented. (tr-auth)

42397 SOME CONSIDERATIONS ON THE IMPORTANCE OF CHANGES INDUCED IN HIGH ENERGY GAMMA RAYS BY THE INTRODUCTION OF WEDGE-SHAPED FILTERS. Renzi, R.; Cavina, C. (Universita, Florence). Nuntius Radiol., 30: 1292-1303(Dec. 1964). (In Italian).

The changes on the geometry and the quality of the beams employed in telecobalt-therapy induced by the introduction of wedge-shaped lead filters into them, are practically negligible. The authors report what they have observed on the entity of these changes by means of dosimetric measurements carried out by the common apparatus, and various types of filters. (tr-auth)

42398 RADIATION THERAPY. Easson, Eric (Christie Hospital, Manchester, Eng.). Nursing Times, 60: 499-500(Apr. 17, 1964).

A brief review is provided of types of radiotherapy and its use in various situations. Various kinds of malignancy amenable to irradiation are considered as well as care of patients following irradiation. In terms of their response to irradiation, malignant tumors can be divided into three groups: radioresistant, radiosensitive, and moderately sensitive tumors. Radioresistant tumors show very little resolution even after very high and tissue-damaging doses of radiation. These include connective tissue sarcomas such as osteogenic sarcoma, fibrosarcoma, chondrosarcoma, as well as adenocarcinoma of the gastrointestinal tract from the stomach to the rectum. Radiosensitive tumors resolve rapidly following irradiation with moderate doses of x rays. This group includes seminoma of the testis, lymphosarcoma, reticulum cell sarcoma, Hodgkin's disease, and two tumors common in children: Wilm's tumor of the kidney and medulloblastoma of the cerebellum. This lower dose of x rays, which may still prove lethal for these sensitive tumors, is not so damaging to the normal tissues in and around the tumor site. The therapeutic margin is wide. Moderately sensitive tumors form the bulk of the radiotherapist's work, and although the therapeutic margin in such cases is usually narrow these are among the most consistently curable of tumors. This group

includes squamous carcinoma affecting the skin, the mouth (including the lips, tongue, palate, and cheeks), carcinoma of the antrum, of the cervix uteri and of the urinary bladder. This group also includes adenocarcinoma of the corpus uteri, some tumors of the breast and thyroid. The nurses role in caring for postirradiation reactions is discussed. (BBB)

42399 DOSIMETRY AND EVOLUTION OF THE TECHNIQUES IN PEDIATRIC RADIOLOGY. **Beraud, Cl.; Deffrenne, P.; Loubier, N. (Hopital d'Enfants Debrousse, Lyon, France). Pediatrie, 19: 817-25(Oct.-Nov. 1964). (In French).**

On the average, young babies exposed to fluoroscopic radiation received 4 to 6 R and young children, 8 to 9 R. Small modifications reduced the non-useful radiations: Al filter to suppress soft rays, an abutment to prevent the tube carriage from coming too close to the patient, and limiting the rheostat to four mA to prevent high intensity rays. A regular surveillance of the equipment with a dosimeter helped avoid excessive exposure and reduced the dose necessary for a given examination. Normal fluoroscopy delivered 8 R to an adult. Radiophotography delivered 800 mR to an adult and 400 mR to a child. Televised fluoroscopy delivered 2, 1, and 0.6 R, respectively. Pulmonary radiography delivered: (from the front): 40, 30, and 20 mR, and (front and profile): 100, 70, and 40 mR. The doses in tomography easily reached 300 to 400 mR for no less than one-half second. The gonads were frequently in the ray's field. In gastric explorations in babies fluoroscopy delivered 35 R in 7 min, fluoroscopy plus radiography delivered 35.6 R in 7 min, amplification of brightness plus radiocinematography delivered 10 R in 6 min, amplification of brightness plus radiography delivered 7 R in 7 min, and radiography alone delivered 600 mR. (TCO)

42400 THE APPLICATION OF A 14-Mev NEUTRON SOURCE TO RADIOTHERAPY. **Greene, D. (Christie Hospital and Holt Radium Inst., Manchester, Eng.); Lomer, P. D. Proc. Roy Soc. Med., 58: 161(Mar. 1965).**

The 14-Mev neutrons used were produced by accelerating deuterium ions on to a tritium target in a sealed tube. The advantage of this reaction is that it gives a useful yield of neutrons at accelerating voltages of the order of 100 kv, so that the tube can be comparable in size to a diagnostic x-ray tube and a conventional high-voltage supply can be used. To obtain a dose rate equivalent to 50 rad/min of x rays at 50 cm from the target, the output required would be 10^{12} neutrons per sec. The experimental generator used gives an output of 10^{10} n/sec with a target life of more than 100 output hr. To increase the output it was necessary to increase the beam current which causes target heating and subsequent loss of tritium. Design studies showed that outputs up to 10^{12} n/sec should be feasible. Efforts are being made in tube development towards achieving an output of 10^{11} n/sec. The neutrons are emitted isotropically from the target and to utilize them for radiotherapy it was necessary to limit them to a well-defined beam. In designing a suitable collimator it was necessary to find a material to give such a beam at a usable distance from the target; steel was the best material for this purpose. Measurements obtained with an experimental steel collimator, 14 in. thick, were compared with the dose distributions across the beam edge, in air, and at different depths in a scattering medium obtained with conventional and megavoltage x rays. The dose distribution across the edge of the neutron beam is comparable with that obtained with conventional quality x rays. Depth dose measurements in water and in tissue-equivalent solution for a 20 × 15 in. field at 80 cm are comparable with those for ^{60}Co γ rays at the same field size and distance. There was a slight build up of dose below the surface over the first three mm. (BBB)

42401 DATA ON TECHNICAL-DOSIMETRY IN APPLICATION TO CLINICAL USE OF ^{137}Cs. **Micell, R. (Universita, Bologna). Radiobiol. Radioterap. Fis. Med., 20: 77-93(Mar.-Apr. 1965). (In Italian).**

Technical and physical-dosimetric data are presented for the therapeutic use of a movable ^{137}Cs 2000 curie source. (tr-auth)

42402 THE VALUE AND POTENTIAL OF TELEVISION IN RADIOLOGIC DIAGNOSIS. **Wise, Robert E. (Lahey Clinic, Boston). Surg. Clin. North Am., 45: 573-83(June 1965).**

The system components used in television fluoroscopy are described and illustrated, and references are made to the reduction in radiation exposure of patients and personnel with such systems. Vidicon and image orthicon cameras are discussed. The resolution or sharpness of the image is superior in the image orthicon system. A disadvantage of the vidicon camera is the persistence of image as the camera or object is moved. The radiation dosage rate controls the design of the coupling used to record the image produced by the image intensifier tube. (TCO)

42403 MEDICAL USES OF RADIUM AND RADIUM SUBSTITUTES. **Public Health Service Publication No. 999-RH-16. (Public Health Service, Washington, D. C., Div. of Radiological Health). July 1965. 60p. Public Health Service. Free.**

Representatives from professional medical societies, leading therapy centers, and governmental agencies attended a 2-day conference, September 3 and 4, 1964, sponsored by the Division of Radiological Health of the U. S. Public Health Service to discuss programs dealing with the management of radium and radium substitutes for medical uses. The discussions were excerpted from the transcript and organized under the five conclusions reached by the conference. These conclusions indicate a need for comprehensive regulatory programs for radium, sealed source design standards for radium, adoption of suitable radium substitutes, research efforts toward developing better and safer sealed sources, and promotion of therapeutic techniques that will reduce radiation exposure to medical personnel. (auth)

42404 THE TREATMENT OF CANCER WITH SPECIAL REFERENCE TO RADIOTHERAPY AND CHEMOTHERAPY. **Mitchell, J. S. (ed.). Cambridge, Eng., Cambridge University Press, 1965. 326p. $18.50.**

Information is included on: developments in carcinochemotherapy; pharmacology of alkylating agents; treatment of acute leukemias, and osteosarcomata; fluorescence of tetracyclines in bone tumors; histological factors in radiotherapy of tumors; bone marrow in prognosis and treatment of malignant disease; clinic for reticuloses; radioactive drug for cancer chemotherapy; treatment of spontaneous tumors in animals by radiotherapy; clinical trials; treatment of pain by nerve blocking; radiation chemistry in understanding biological actions of ionizing radiations; malignant disease in Hong Kong and Macao; biochemical basis of biological actions of x rays; advanced malignancy; steroid treatment in children; Waldenstrom's macroglobulinaemia; oxygen effects on radiotherapy; effects of vasodilator and vasoconstrictor drugs on tumor oxygen tension; treatment of carcinoma of the uterus by radium and surgery; and diagnostic radiology as an aid to radiotherapy and chemotherapy. (P.C.H.)

CHEMISTRY

General

Refer also to abstract 42801.

42405 (BNWL–81) LABORATORY EVALUATION OF DECONTAMINATION AGENTS FOR INCONEL PIPING CONNECTORS. FitzPatrick, V. F.; Richman, R. B. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). July 1965. Contract AT(45-1)-1830. 8p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Laboratory tests were conducted to evaluate three candidate solutions for decontaminating Inconel piping connectors. The reagents tested included: an inhibited sulfuric–oxalic acid solution (0.3M H_2SO_4, 0.1M $H_2C_2O_4$); Sulfam-3, a proprietary sulfamic acid base decontaminant; and Bisulf-16, a proprietary sodium bisulfate base decontaminant. The sulfuric–oxalic mixture proved to be the most effective; decontamination factors were 4.7 and 11.5 for solution temperatures of 70 and 80°C at 30 min exposure. The decontamination factors for Sulfam-3 and Bisulf-16 at 70°C and 30 min were only 2.9 and 1.8. Lower temperatures and reduced acid concentrations in the sulfuric–oxalic mixture were less effective. The results of corrosion tests of sulfuric–oxalic mixtures on reactor components have been reported previously. For a temperature of 70°C and 30 min contact, the corrosion of aluminum would be <0.05 mil, of carbon steel <0.05 mil, and of stainless steel and Inconel <0.01 mil. These corrosion penetrations are not excessive, and no major corrosion problems are expected from the use of a properly inhibited 0.3M–0.1M, sulfuric–oxalic acid mixture. (auth)

42406 (INP–406/C) THE ELECTROLYTIC PREPARATION OF LEAD TARGETS FROM STABLE ISOTOPES ^{206}Pb AND ^{207}Pb IN SULPHATES FORM. Mikulski, J.; Szeglowski, Z. (Institute of Nuclear Physics, Krakow (Poland)). Apr. 1965. 4p. Dep.

A simple method of preparing lead targets from lead sulphate containing stable ^{206}Pb or ^{207}Pb isotopes is described. Lead was deposited by electrolysis first from lead sulphate in NaOH solutions and then from solutions in lead perchlorate. (auth)

42407 (UJV-1172/64) CHEMICKO-INZENYRSKY VYPOCET PNEUMATICKE SUSARNY. (Chemical and Technological Calculations of Pneumatic Drier). Seidl, K. (Ustav Jaderneho Vyzkumu, Ceskoslovenska Akademie Ved, Rez). 1965. 32p. Dep. mn.

Basic parameters of a pneumatic drier (so-called Micro-Drier) for dehydration of 10% ammonium diuranate suspension were calculated. The designed productivity is 90 kg wet material/hr. The Micro-Drier is a grinding and drying equipment that has no moving parts because grinding and dehydration are achieved by pressurized elastic fluids such as compressed air. Ground particles are collected in a cyclone, dimensions of which are presented. The height of the active part with a diameter of 0.81 m is 1.12 m. A standard cyclone NIOGAZ has a diameter of 0.19 m and is 0.8 m high. The pressure drop of the cyclone is 64 mm H_2O. Further, thermal and materials balance, drying time, terminal velocity of particles, and heat losses in the equipment were calculated. Calculation shows that effective dehydration of ammonium diuranate (ADU) is feasible. (auth)

Analytical Procedures

See also Separation Processes and Procedures.

Refer also to abstracts 42739 and 42807.

42408 (AEET/Met./5) SPECTROGRAPHIC ANALYSIS OF TITANIUM DIOXIDE. Krishnan, T. S.; Dhall, Prem Kumar; Rao, A. S. (Atomic Energy Establishment, Trombay (India). Metallurgy Div.). 1964. 14p. Dep. mn.

A spectrographic method is described for the estimation of the following impurities in titanium dioxide: Ni, Co, Sn 0.001 – 0.1%; Pb 0.0025 – 0.1%; Sb 0.005 – 0.1%; Cu 0.0075 – 0.1%; Nb 0.05 – 0.5%; Mn, Cr, Mg 0.001 – 5%; Fe, Al 0.005 – 5%; V 0.005 – 0.5%; and Si 0.25 – 5%. The method involves mixing the sample in the ratio 1:2 with a buffer containing equal portions of graphite and zinc oxide and then exciting in a d-c arc using a shallow cup electrode. Using titanium as the internal standard, the standard deviations for most of the elements lie within 10% of the estimated averages of the above concentrations. The method is applicabie to the analysis of titanium and its alloys after conversion of the metals to the oxide form. (auth)

42409 (AWRE-O–37/65) DATA PROCESSING FOR ISOTOPIC ANALYSIS BY MASS SPECTROMETRY. Ridley, R. G.; Young, W. A. P. (Atomic Weapons Research Establishment, Aldermaston (England)). July 1965. 20p. Dep. mn; BIS $0.60; HMSO 3s.

A description is given of the methods by which computer techniques are applied to the output of the various types of solids and gas mass spectrometers in use at AWRE. (auth)

42410 (BNWL-SA–51) MULTIDIMENSIONAL GAMMA-RAY SPECTROMETRY AND ITS USE IN HEALTH PHYSICS. Perkins, R. W.; Nielsen, J. M. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). [1965]. Contract AT(45-1)-1830. 28p. (CONF-650616–7). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

From Health Physics Society Annual Meeting, Los Angeles.

Recent developments in multidimensional gamma-ray spectrometry allow the direct instrumental analysis of complex radionuclide mixtures. This has been accomplished by a combination of anticoincidence shielding and coincidence techniques. The detector systems and their response are described, and some of the applications of the spectrometry are summarized. (D.L.C.)

42411 (CEA-R-2757) ANALYSE DES SOLIDES AU SPECTROMETRE DEMASSE A ETINCELLES. (Analysis of Solids by Spark Source Mass Spectrometry). Stefani, Rene; Desjardins, Michel; Brun, Jean-Claude; Cornu, Ayme; Bourguillot, Robert (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). May 1965. 23p. Dep. mn.

The spark source mass spectrometer MS7 has been designed to determine traces of impurities in solids without standards. An atlas of 12,000 lines, assembled in the Grenoble laboratory, allows a quick investigation of mass spectra, notwithstanding their complexity due to multiply charged and polyatomic darkening. Photometric measurements increase accuracy if a calibration curve is known for each photoplate. Further, reproducibility is better if random fluctuations of matrix-line darkening are corrected. So far, in a concentration range of 0.01 to 1,000 ppm (atomic), reproducibility is approximately 20 per cent, but absolute value of results depends on "sensitivity coefficients." (auth)

42412 (GAT-T–1224) ISOTOPIC MEASUREMENT OF URANIUM BY MASS SPECTROMETRY. Kauffman, G. F.; Tabor, C. D. (Goodyear Atomic Corp., Piketon, Ohio). July 16, 1965. Contract AT(33-2)-1. 13p. (CONF-650803–7). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From IAEA Symposium on Nuclear Materials Management, Vienna.

A brief description is given of the basic principles of mass spectrometry and of the specific detection systems and ion sources used for uranium analyses. Double-standard and single-standard relative methods are considered as well as absolute methods and the determination of uranium concentration. Applications of the methods in umpire analyses, product analyses, accountability for receipts are discussed. (D.L.C.)

42413 (IS-T-26) SPECTRAL DETECTION SENSITIVITIES OF THE ELEMENTS IN THE PREMIXED, FUEL-RICH, OXYACETYLENE FLAME (thesis). Golightly, Danold Wayne (Ames Lab., Iowa State Univ. of Science and Tech.). May 1965. Contract W-7405-eng-82. 46p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Knowledge of the demonstrated reducing nature and stability of the premixed, fuel-rich, oxyacetylene flame prompted an investigation of its total analytical utility. The flame was evaluated as a spectrochemical source in terms of the detection sensitivities of 67 elements, 40 of which were determined in this study. Comparison with flame atomic absorption and porous cup and rotating disk electrode, spark, emission detectabilities proved flame emission a valuable analytical tool. The significance of comparable flame and spark detection sensitivities was noted with regard to equipment cost and space considerations. Also, the complementary nature of flame atomic absorption and flame emission techniques was observed. A combination of table model flame atomic absorption and flame atomic emission instrumentation was observed as a means for detecting 52 elements at or below a 1 μg/ml solution concentration. The relative roles of excitation potential and metal monoxide dissociation energies in establishing flame emission detection sensitivities were discussed. Population of atomic levels above four electron volts was not accomplished readily in the oxyacetylene flame atmosphere. In addition, previously unobserved flame spectra of iridium and osmium were reported. (auth)

42414 (JEN-146-DQ/I-47) ANALISIS ESPECTROQUIMICO DE LECTURA DIRECTA DE ALEACIONES DE MAGNESIO. (Direct-Reading Spectrochemical Analysis of Magnesium Alloys). Roca Adell, M. (Junta de Energia Nuclear, Madrid (Spain). Division de Quimica). 1964. 9p. Dep. mn.

A Quantometer was applied to the determination of aluminum, beryllium, calcium, iron, silicon, and zinc in Magnox alloys, after conversion of the samples to the oxide. For aluminum, whose concentration is relatively high, the conducting briquet technique with an interrupted discharge is employed, using the magnesium as the internal standard. For the other elements, a total burning method with direct current arc is employed, using also the magnesium as the internal standard. The standard deviations of determinations ranged from ±2.2% to ±6.6%. (auth)

42415 (JEN-147-DQ/I-48) DETERMINACION DE FOSFORO EN MINERALES DE URANIO Y SOLUCIONES PROCEDENTES DE SU BENEFICIO. (The Determination of Phosphorus in Uranium Minerals and Resulting Solutions). Petrement Eguiluz, J. C.; Parellada Bellod, R.; Fernandez Cellini, R. (Junta de Energia Nuclear, Madrid (Spain). Division de Quimica). 1964. 12p. Dep. mn.

Interferences of several elements present in Spanish uranium minerals in the phosphorus determination by the spectrophotometrical method of the molybdovanadatephosphoric acid are studied. A method is described with a previous separation of these elements by a cationic resin. This method is successfully applied to the phosphorus determination in acid or alkaline lixiviation solutions of uranium minerals, as well as in the eluates of ion exchange resins used technically for the concentration of solutions with a low uranium content. (auth)

42416 (LA-3314) THE SPECTROPHOTOMETRIC DETERMINATION OF PLUTONIUM AS THE ARSENAZO I COMPLEX. Dahlby, J. W.; Waterbury, G. R. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Apr. 30, 1965. Contract W-7405-eng-36. 11p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Microgram quantities of plutonium are separated from most other ions using an anion exchange resin method and are determined spectrophotometrically as the arsenazo I [3-(2-arsonophenylazo)-4,5-dihydroxy-2,7-naphthalenedisulfonic acid] complex in 0.4 M perchloric acid. The molar absorptivity of this complex is large, 22,000, and the method is sensitive; plutonium concentrations as small as 0.6 μg/ml may be determined reliably by this method. Based on a total of fifty-four determinations of 8.2, 43, and 86 μg of plutonium in 10 ml of solution, relative standard deviations of 5.8, 2.2, and 1.8%, respectively, were calculated. Of fifty foreign ions investigated, antimony, hafnium, iron, palladium, tantalum, tin, tungsten, uranium, and zirconium interfered seriously when present in fifty-fold excess. (auth)

42417 (MLM-1256) NEW TECHNIQUES IN THE GAMMA ACTIVATION ANALYSIS OF BERYLLIUM. Rook, H. L. (Mound Lab., Miamisburg, Ohio). Apr. 19, 1965. Contract AT-33-1-GEN-53. 5p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

The gamma activation method of analysis for total beryllium in beryllium metal was modified to make it a routine procedure. A five-gram sample of beryllium irradiated with antimony-124 gave a standard deviation due to counting statistics alone of ±0.12 percent at a 95 percent confidence level with two five-minute counts. The precision of the method, calculated from the deviation between duplicate analyses, was ±0.13 percent. The relative error at a 95 percent confidence level is ±0.26 percent. (auth)

42418 (NIJS-R-448) THE FLAME PHOTOMETRIC DETERMINATION OF ALKALI METALS, ALKALINE EARTHS, AND COPPER IN NUCLEAR GRADE URANIUM. Podobnik, B.; Korosin, J.; Kosta, L. (Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia)). Apr. 1965. 12p. Dep. mn.

A method, which involves prior chemical separation of uranium from impurities by tributyl phosphate extraction, is described for the determination of alkalies, alkaline earths, and copper in nuclear grade uranium. The characteristic emission lines, excited in hydrogen–oxygen flame, are isolated by a small monochromator and recorded photoelectrically. Using 3-gram samples, 0.005 ppm of Li, 0.001 ppm of Na, 0.05 ppm of K, 1 ppm of Mg, 1.5 ppm of Ba, and 2 ppm of Cu can be determined respectively in uranium, with reproducibility better than ±3%. Some interelemental interferences are discussed, and the possibilities of their elimination are described. The method can be used without modification for the analysis of uranium containing up to 100 ppm of impurities. (auth)

42419 (NIJS-R-451) DIRECT SPECTROGRAPHIC DETERMINATION OF IMPURITIES IN URANIUM TETRAFLUORIDE. Podobnik, B.; Spenko, M. (Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia)). May 1965. 9p. Dep. mn.

A direct spectrographic method for the determination of impurities in UF_4 is described. The sample in the graphite electrode cavity was covered with a layer of alumina and a d-c arc was struck against the upper electrode. Alumina prevented the volatilisation of uranium tetrafluoride, thus, avoiding high spectral and background interferences. To stabilize the discharge, the controlled atmosphere of argon and oxygen was used. According to their volatility, the impurity elements were divided in three categories: of high volatility (B, Si, Ge), of medium volatility (Ti, Zr, Nb, Mo, V, Al etc.), and of low volatility (Ni, Pb, alkaline earths etc.). The impurities of the first and second kind were analysed successfully. In the procedure the principle of internal standard was employed; for the most volatile elements germanium, and for medium volatile aluminum. The sensitivities, based on the volatilities of the metal fluorides, in the most cases agreed with the sensitivities of well-known carrier distillation spectrographic method. The coefficients of variation varied from 8 to 25 percent at 25 ppm concentration level. The method eliminates the pyrohydrolytical procedure, used up till now, and thus assures no losses of impurities during chemical pre-treatment of the samples. (auth)

42420 (NLCO-955, pp 1.1-7) X-RAY SPECTROMETRIC DETERMINATION OF THORIUM IN AQUEOUS AND ORGANIC SOLUTIONS. Blank, G. R.; Dingeldein, W. H. (National Lead Co. of Ohio, Cincinnati).

X-ray spectrometric methods were developed for the determination of thorium in all aqueous solutions and in organic solutions composed of mixtures of diamyl amyl-

phosphonate in Solvesso-100 or di-sec-butyl phenylphosphonate in Solvesso-100. An aqueous or organic sample can be prepared and analyzed in 10 to 15 minutes. A separate, more accurate method was established for determining the thorium content of aqueous product samples on a weight basis. This analysis can be completed in approximately 40 minutes. (auth)

42421 (NLCO–955, pp 2.1-12) THE NEUTRON ACTIVATION FACILITY AT THE NATIONAL LEAD COMPANY OF OHIO. Twitty, B. L. (National Lead Co. of Ohio, Cincinnati).

A neutron activation facility was designed around a 150-kv Cockcroft-Walton-type neutron generator. Both thermal and 14-Mev neutrons are utilized. Special features of the system include the design of the shielding and safety facilities; an automatic, rapid, rabbit transport system; counting systems; and a sequential programming timer to control all phases of the activation and counting program. (auth)

42422 (NLCO–955, pp 3.1-7) A VERSATILE SEQUENTIAL PROGRAMMING TIMER. Kramer, J.; Bailey, M. R. (National Lead Co. of Ohio, Cincinnati).

A versatile, electronic, sequential programming timer was developed and installed to control the five operational steps required for neutron activation analysis. Time intervals varying from 1.7 seconds to 4.6 hours may be selected. Timing is accurate to within one part in 10,000. (auth)

42423 (NP-15366) REVIEW ON THE ANALYTICAL METHODS FOR THE STABLE AND RADIOACTIVE CAESIUM. Yamagata, Noboru (Institute of Public Health, Tokyo (Japan). Dept. of Radiological Health). Mar. 1965. Contract 140/R2/RB. 72p. Dep. mn.

Analytical methods for determination of cesium are reviewed. Emphasis is placed on radiochemical separation methods and on analytical methods for trace amounts of stable cesium. Sample preparation and treatment are described. Separation methods based on precipitation, ion exchange, solvent extraction, paper chromatography and electrophoresis, and use of non-isotopic carrier in the carrier-free separation of cesium are discussed. Gravimetric, radioactivation, spectrographic, flame-photometric, and other methods of analysis are considered. (M.C.G.)

42424 (NYO–3276-10) HIGH ALTITUDE BALLOON SAMPLING PROGRAM—FIFTH QUALITY CONTROL. A Progress Report. Girr, Henry R.; Sanderson, Colin G. (Isotopes, Inc., Westwood, N. J.). Aug. 31, 1965. Contract AT(30-1)-3276. 21p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Data are presented from quality control studies of unexposed filter papers analyzed and processed during the period from Jan to May 1965 for the same nuclides as were filter papers exposed during low-altitude aircraft sampling and high-altitude balloon sampling of the atmosphere for fallout. The blank samples were analyzed for ^{109}Cd, ^{113}Cd, ^{144}Ce, ^{137}Cs, ^{55}Fe, ^{54}Mn, ^{147}Pm, ^{238}Pu, ^{239}Pu, ^{125}Sb, and ^{90}Sr. Procedures used for the preparation of samples and the sequential separation of the isotopes are included. (C. H.)

42425 (RFP–502) MEASUREMENTS INVOLVED IN SHIPPING PLUTONIUM OXIDE. Byrne, J. T.; Caldwell, C. E.; Delnay, R. L.; Moseley, J. D.; Oetting, F. L. (Rocky Flats Div., Dow Chemical Co., Denver, Colo.). Aug. 10, 1965. Contract AT(29-1)-1106. 88p. Dep. mn; CFSTI $4.00 cy, $0.75 mn.

The major causes of shipper-receiver differences, during shipments of plutonium oxide, were identified, and methods of minimizing the differences were developed. Acceptable levels of shipper-receiver differences were demonstrated, and recommendations for further improvement are made. Plutonium oxide, properly prepared, is stable and sufficiently soluble to use as a shipping form. The equipment and procedures used in this study, for preparation of acceptable plutonium oxide, are recommended as specifications. Bulk-measurement errors are minimal when proper procedures and equipment are used. Retention of plutonium oxide in the shipping cans was found to be negligible. A template-sampling method appears to be adequate. A procedure for the non-destructive calorimetric determination of plutonium in a shipping container was demonstrated. The average shipper-receiver differences for 12 interplant shipments, of oxide prepared from oxalate or peroxide, between Hanford and Rocky Flats was +0.14 percent, with a standard deviation of 0.23 percent. Using analytical laboratory results, from the same laboratory only, the average shipper-receiver difference for these interplant shipments was +0.10 percent with a standard deviation of 0.18 percent. A similar group of 12 intraplant shipments, at Rocky Flats gave an average shipper-receiver difference of −0.06 percent with a standard deviation of 0.19 percent. The positive shipper-receiver difference (+0.14 percent) for the interplant shipments is explained by the fact that all receiving samples were analyzed in an atmosphere of lower humidity than that in which the oxide was initially prepared. Consequently, the analyses show a progressive increase in plutonium concentration because of loss of adsorbed moisture. The interplant shipments also included two batches (four shipments) of oxide prepared by denitration of plutonium nitrate. Results from this material were erratic, indicating heterogeneity and instability because of incomplete calcination. The shipper-receiver differences obtained with denitrated oxide are not included in the above results. The ceric sulfate redox titration method was used to determine plutonium for calculation of shipper-receiver differences. This method is subject to sampling error, and it requires that the oxide be completely soluble. It is believed that the calorimetric method could be used for the determination of plutonium in shipping containers. The calorimetric method requires precise measurements of the isotopic composition. But it does not require: (1) that the oxide be homogeneous, (2) that it be completely soluble in a limited time, or (3) that careful weight measurements be made. The precision of the method is comparable to the ceric sulfate redox titration method as performed at Rocky Flats and Hanford (~0.06 percent RSD). The bias between laboratories, for the calorimetric method, should be less than the bias found for the wet chemical methods. (auth)

42426 (TIM–936) CANEL MATERIALS LABORATORY MANUAL—ANALYTICAL SECTION. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). [1964]. Contract AT(30-1)-2789. 227p. Dep. mn; CFSTI $6.00 cy, $1.25 mn.

A compilation is presented of analytical methods and procedures which were developed and used for the analysis of refractory metals and alloys, nuclear materials, and alkali metals. (D.L.C.)

42427 USE OF SILICON BARRIER DETECTORS IN DETERMINATION OF THE ISOTOPIC CONTENT OF ALPHA EMITTERS. I. DETERMINATION OF URANIUM. Acena Barrenechea, M. L. (Junta de Energia Nuclear, Madrid). Anales Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 61: 13-82(Jan.-Feb. 1965). (In Spanish).

A method for the determination of the isotopic content of alpha-emitting elements is described with specific consideration of application of the method to uranium. The errors associated with the method are considered in detail. The average standard deviation amounts to less than 3% for ^{234}U, 1.2% for ^{235}U, and 2.1% for ^{238}U. (D.C.W.)

42428 STUDIES IN RARE METAL TUNGSTATES—AMPEROMETRIC TITRATIONS OF LANTHANUM(III) WITH ALKALI TUNGSTATE. Gupta, C. M. (Univ. of Rajasthan, Jaipur, India). Bull. Chem. Soc. Japan, 38: 1401(Aug. 1965).

Amperometric titrations of lanthanum nitrate with sodium tungstate were performed to study the possibility of developing the reaction as an analytical method for the determination of lanthanum at a definite pH value. A manual polarograph, with a scalamp galvanometer as a current recorder, was used for the amperometric titrations. The precipitation of $La_2O_3 \cdot 3WO_3$ was quantitative over the pH range from 5 to 6.5. The results were accurate

within an error range of 1% at 10^{-3}M concentrations of the reactants studied. (F.J.H.)

42429 APPLICATION OF THE FUSED ZONE TECHNIQUE TO THE PURIFICATION OF YTTRIUM SALTS. Schiffmacher, Gerard (CNRS, Bellevue, France). Compt. Rend., 260: 6111-14(June 9, 1965). (In French).

It is shown that the fused zone technique can be utilized for the purification of some rare earths, particularly Y, by using a compound with low fusion point such as the bromate. Preliminary tests showed that the chloride, nitrate, and perchlorate salts can not be used in the fused zone technique for the rare earths. Preliminary tests were made to determine the direction of displacement of the rare earths with respect to yttrium. In the lower part of the ingot Dy, Gd, and Lu were concentrated and in the upper part Yb, Tm, Ho, and Er were concentrated. The results showed that Y cannot be purified from Er by this method. The other impurities present however are eliminated with a purification factor of almost 4 after 10 passes. The impurity concentration, not counting Er, is lowered from 1310 to 125×10^{-6}. (J.S.R.)

42430 UTILIZATION OF POWDER ELECTRODES FOR THE DETERMINATION OF H–D ISOTOPE EFFECTS. Znamirovschi, V.; Babes, V. (Univ. Babes Bolyai, Cluj). Electrochim. Acta, 10: 713-16(July 1965). (In French).

The possibilities of utilization of powder electrodes for the protection and evaluation of the H–D isotopic effect by measuring the powder electrode potential in aqueous solutions of various isotopic concentrations was studied in order to establish the relations between electrode potential and the concentration of the heavy isotope. The evolution in time of the electrode potential from the beginning of the bubbling of the gaseous hydrogen was determined. It was established experimentally that the emf of the cell varies linearly with the concentration of deuterium in water. The results showed an isotopic H–D effect on the potential of the powder electrode. The variation of the electrode potential could be used to detect deuterium traces of the order of 0.5 to 1%. It appeared that the bubbling gas was always H_2 and the appearance of the isotopic effect seemed to be the result of an H–D isotopic exchange between the chemisorbed phase and the liquid phase, an exchange catalyzed by the powder used. (J.S.R.)

42431 THE POSSIBILITY OF NONDESTRUCTIVE, RADIOMETRIC ANALYTICAL CONTROL OF CERTAIN MEDICINES IN PHARMACY. Schiller, P.; Jombik, J. Farm. Obzor, 33: 423-30(Sept. 1964). (In Slovak).

Two kinds of measuring apparatus were devised. One consisted of a measuring chamber (housing a ^{90}Sr source, 2 G-M tubes and a tray for the samples), a nuclear counter, and a time switch. The source was positioned and shielded so that the counter could receive only the reflected β radiation. The sample had to be thick enough to present a saturated layer for reflecting the radiation. Impulses per time readings were compared with values on a calibration curve, which was obtained from only 2 readings (min and max) of standards. A second device was made up of a measuring head, an impulse counter, and an electronic voltmeter with an indicator showing the percentage of a component in the sample. The measuring head contained a Pb block which held the ^{90}Sr + ^{90}Y β source and controlled the direction of the emission and 2 G-M tubes connected in parallel and used as detectors. This device was designed to carry out tests on a serial basis. (OID)

42432 APPLICATION OF TERTIARY AMINE EXTRACTION TO THE DETERMINATION OF URANIUM IN BIOLOGICAL MATERIALS. Beasley, T. M. (General Electric Co., Richland, Wash.). Health Phys., 11: 1059-65(Oct. 1965). (HW-SA-3666).

An analytical solvent extraction procedure for the separation of uranium from biological materials is described. Special emphasis is placed on the analysis of urinary excreta from personnel involved in the processing of irradiated thorium. Following coprecipitation on alkaline earth phosphates, uranium is purified from its daughter products by liquid–liquid extraction from acid-deficient aluminum nitrate solution using the tertiary amine, alanine-336. Scrubbing of the organic phase with hydrochloric acid removes thorium and other daughter products which can be recovered by other separation schemes. Following back extraction and evaporation to dryness, the uranium can be directly plated for total alpha counting or alpha energy analysis, or aliquots of the solution may be taken for fluorometric analysis. Application of the procedure to the determination of uranium in tissue is also discussed. (auth)

42433 ^{22}Na IN MILK. Cigna, Arrigo A.; Giorcelli, Franco G. (Comitato Nazionale per l'Energia Nucleare, Rome). Health Phys., 11: 1095-7(Oct. 1965).

Sodium-22 was detected and measured in milk samples collected in Italy in the period 1961 to 1964. The concentration of 20 pC/l was never exceeded. (C.H.)

42434 DETERMINATION OF THE ARSENIC IN VEGETABLES BY RADIOACTIVATION AND GAMMA-SPECTROMETRY TECHNIQUES. Kirchmann, R. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.); Roderbourg, J. Intern. J. Appl. Radiation Isotopes, 16: 457-60(Aug. 1965). (In French).

Activation analysis in combination with γ spectrometry permitted the determination of natural levels of arsenic in plant matter. The isotope ^{76}As was utilized for this determination after a chemical separation. The separation was carried out after mineralization (wet-ashing) of the irradiated sample, by precipitation of the As as As_2S_5. The recovery was on the order of 65% for the chemical procedure and the limit of detection for As was 2×10^{-6}g. The main advantage of the described method consists in the speed for serial determinations. (auth)

42435 APPLICATION OF RADIONUCLIDES TO THE DETERMINATION OF PHOSPHORUS IN AS-GROWN BERYLLIUM OXIDE CRYSTALS. Bingham, C. D.; Austerman, S. B. (Atomics International, Canoga Park, Calif.). Intern. J. Appl. Radiation Isotopes, 16: 499-500 (Aug. 1965).

Radioisotope tracer chemistry was used to measure the concentration of phosphorus in small, as-grown beryllium oxide crystals. Beryllium oxide crystals were grown from a melt of ^{32}P-labeled calcium phosphate, lithium molybdate, and molybdic oxides. The crystals were recovered, washed, and 2π β-counted. The observed activity, corrected for decay, permitted a calculation of the phosphorus content of the crystal. (F.J.H.)

42436 POTENTIOMETRIC ACID-BASE TITRATIONS IN MOLTEN SALTS. THE ACID CHARACTER OF GROUP (VI) OXIDES AS INFERRED FROM THEIR REACTION WITH MOLTEN KNO_3. Shams El Din, A. M.; El Hosary, A. A. (National Research Centre, Dokki, Cairo). J. Electroanal. Chem., 9: 349-60(May-June 1965).

The reactions between CrO_3, MoO_3, and WO_3, and fused KNO_3 at 350°C were studied by measuring the variation in the potential of an oxygen electrode relative to an Ag/Ag(I) reference electrode. When the reactions come to an end, the reaction products are determined by acid-base titrations in situ, using Na_2O_2 as titrant. The acid strength of the three oxides decreased in the order $CrO_3 > MoO_3 > WO_3$. This was evident from the variation of the potential of the oxygen electrode with time, and from the fact that, whereas dichromate was formed in case of CrO_3, only the triomolybdate was obtained from the reaction of MoO_3 with fused KNO_3. WO_3 was stable under the same experimental conditions. Neutralization of all the reaction products with Na_2O_2 led to the formation of the most basic anion, XO_4^{2-}. Acid-base equilibrium constants for the reactions: $2\ CrO_3 + O^{2-} \rightarrow Cr_2O_7^{2-}$, $CrO_3 + O^{2-} \rightarrow CrO_4^{2-}$, $MoO_3 + O^{2-} \rightarrow MoO_4^{2-}$, $Mo_3O_{10}^{2-} + 2O^{2-} \rightarrow 3\ MoO_4^{2-}$, and $WO_3 + O^{2-} \rightarrow WO_4^{2-}$ were calculated. The kinetics of the reaction: $2\ CrO_3 + 2\ NO_3^- \rightarrow Cr_2O_7^{2-} + N_2O_5$ were established. The reaction is bimolecular with respect to CrO_3 and has an activation energy of 25.3 kcal/mole. (auth)

42437 QUANTITATIVE DETERMINATION OF TWO γ-EMITTING, SIMULTANEOUSLY PRESENT ISOTOPES BY MEANS OF A ONE-CHANNEL AMPLITUDE ANALYZER.

PART II. Gallyas, Miklos; Fodorne Csanyi, Piroska (Lorand Eotvoes Univ., Budapest). Magy. Kem. Folyoirat, 71: 234-8(June 1965). (In Hungarian).

The method developed by D. F. Covell (Anal. Chem., 31: 1785(159)) for determining an isotope on the basis of the area of the photopeak of its spectrum was modified. Instead of carrying out measurements in each channel, the position of the channel was adjusted to the discriminator voltage corresponding to the minimum of the area toward the lower energies. The area under the photopeak with a channel width of (2n + 1)v, where n designates the number of channels required to reach saturation, was determined. The whole operation requires only 3 steps, measurement of the area under the photopeak and that of the activities of the last 2 channels considered, in order to obtain a value for the area free from Compton activity. The area derived from the sum of activities and that determined by direct measurement with the (2n + 1)v channel width did not agree with each other; therefore, a "computation factor" was introduced, making it possible to apply Covell's equation. The statistical error in this modified method was about twice larger than in the original method but the scatter of the data remained unchanged. The time required to make the measurements was reduced by about a factor of 5. (TTT)

42438 OSCILLOPOLAROGRAPHY OF EUROPIUM. Ide, Yasushi. Mem. Fac. Sci., Kyushu Univ., Ser. C, 5: No. 3, 73-84(1964).

Well-defined graphs of dE/dt vs E were obtained with 0.1 to 2m$\underline{M}$-Eu^+ in 0.3 to 2$\underline{M}$-KCl. Anodic and cathodic incisions corresponding to the reaction $Eu^{3+} + e = Eu^{2+}$ were observed. A second cathodic incision was observed at pH >3.25 in the presence of dissolved O or H_2O_2; it is attributed to the irreversible formation of a chlorohydride of Eu adsorbed on the mercury cathode, the incision being caused by the faradaic current required for the reduction of H^+ to H^-. At KCl concentration >$\underline{M}$, all incisions are shifted to more negative potentials because of the formation of a chloro-complex. The depths of the incisions can be used for determining Eu^{3+}; the first cathodic incision can be used in the presence of other rare-earth elements. At pH >4, its depth is decreased because $Eu(OH)_3$ is formed by the OH^- resulting from the reduction of O. The Eu was determined at pH >3.25 in the presence of O, and at pH <3.9 in its absence. The calibration graph was improved in the absence of O. (Analytical Abstr., Vol. 12, Aug. 1965)

42439 SEPARATION OF SOME METALS BY EXTRACTION-CHROMATOGRAPHY USING NEW NEUTRAL PHOSPHORO-ORGANIC COMPOUNDS. Mikulski, J.; Stronski, I. (Inst. of Nuclear Physics, Krakow, Poland). Nature, 207: 749-50(Aug. 14, 1965).

The separation of metals by extraction-chromatography using tetrabutylpyrophosphate (TBPP) and a mixture of TBPP with tetrabutylhypophosphate (TBHP) was investigated. The results showed that divalent ions of transition metals are not adsorbed from concentrated hydrochloric acid solutions and can be eluted in the first free volume of the column, whereas ions of trivalent iron become adsorbed and can be washed out with diluted HCl. Some experiments were also carried out using HNO_3 as an eluant. (P.C.H.)

42440 ACTIVATION ANALYSIS OF ZIRCONIUM IN HAFNIUM BY MEANS OF PHOTONUCLEAR REACTION. Oka, Yoshinaga; Kato, Toyoaki (Tohoku Univ., Sendai). Nippon Kagaku Zasshi, 86: 835-9(Aug. 1965). (In Japanese).

Investigations on photonuclear reactions to establish the application of these reactions for determination of Zr in Hf were carried out using the linear accelerator operated at a maximum energy of 20 Mev. Synthetic samples of a ZrO_2-HfO_2 mixture were prepared by adding known amounts of ZrO_2(10.8 μg ~ 2.2 mg) to 100 mg of pure HfO_2 and bombarding the samples for 1 hr by γ rays produced by the linear accelerator. The γ flux was about 5×10^6 R/min. The counting rate of the photoelectric peak at 0.913 Mev, which was attributed to $^{89}Zr(T_{\frac{1}{2}} = 79.3$ hr) produced by the $^{90}Zr(\gamma,n)$ reaction, was sufficient for determination of Zr after the relatively short-lived radionuclides, i.e., ^{15}O, ^{89m}Zr etc., had decayed out. Hf was used as an internal monitor of the γ flux. The respective counting rates of the photoelectric peaks after a cooling period of about 4 days were estimated and the ratio of the counting rate corrected at a time of the end of bombardment, $R_{A\theta} = {}^{89}Zr/{}^{175}Hf$, was computed. A proportionality was obtained between $R_{A\theta}$ and the ratio of the weight, $R_w = ZrO_2/HfO_2$. Hence, Zr can be determined in Hf by the photoactivation and the subsequent determination of photoelectric peak intensities of both radionuclides to obtain the ratio of the counting rate, $R_{A\theta}$. Zr concentration in Hf samples as little as ~10 ppm can be determined nondestructively by this method. (auth)

42441 MICRODETERMINATION OF RUTHENIUM IN URANIUM COMPOUNDS. Vita, O. A.; Trivisonno, C. F. (Goodyear Atomic Corp., Piketon, Ohio). Nucl. Appl., 1: 375-80(Aug. 1965). (GAT-T-1215).

A method that is essentially selective was developed for the micro-determination of ruthenium in uranium compounds. The ruthenium is separated by distillation as ruthenium tetroxide from an acid permanganate medium and is determined spectrophotometrically at a wavelength of 460 mμ as its divalent complex with 4,7-diphenyl-1,10-phenanthroline (bathophenanthroline). The complex extracted with 1-hexanol has a molar absorptivity of 27,000 liters/(mole cm). A quantity of 0.2 μg of ruthenium can be detected, and it is possible to measure concentrations of 0.02 μg of ruthenium per gram of sample or even lower if sufficient sample is available. The limit of error in determining 10 μg of ruthenium is ±10% at the 95% confidence interval. (auth)

42442 ACTIVATION ANALYSIS BY HIGH-ENERGY PARTICLES. Tilbury, Roy S.; Wahl, Werner H. (Union Carbide Corp., Tuxedo, N. Y.). Nucleonics, 23: No. 9, 70-8(Sept. 1965).

The advantages of activation analysis using high-energy neutrons, photons, and charged particles, especially for light elements, are discussed. Examples are described. (48 references). (M.C.G.)

42443 DETERMINATION OF THE RARE EARTH ELEMENTS IN HOT SPRING WATER BY THE RADIOACTIVATION METHOD. Ikeda, Nagao; Kondo, Yoji; Yamashita, Hiroshi (Tokyo Univ. of Education). Radioisotopes (Tokyo), 14: 357-62(Sept. 1965).

The contents of lanthanum, samarium, europium, and scandium were determined in several hot springs in Nasu and Kusatsu areas by the aid of the radioactivation method. The mixed hydroxides precipitated from 1 ~ 2l of the spring water were ignited and then subjected to the neutron irradiation in the JRR-1 reactor for 5 hrs. The total rare earth element fraction was separated chemically and the radioactivity was measured with a single channel γ spectrometer. These elements were present in five springs tested in the range of 1.2 ~ 5.7 μg La/l, 0.8 ~ 2.6 μg Sm/l, 0.2 ~ 0.6 μg Eu/l and 0.5 ~ 3.3 μg Sc/l. Distribution of these elements between the spring water and the sinter deposit of the Moto-yu spring, Nasu, was also investigated. (auth)

42444 ASSAY OF MIXTURES OF ^{65}Zn AND ^{32}P IN PLANT MATERIAL. Haasbroek, F. J. (Western Province Fruit Research Inst., Stellenbosch, S. Africa). S. African J. Agr. Sci., 4: 439-41(Sept. 1961).

In tracer experiments with plant material the lowest possible activities must be used to avoid radiation effects. Maximum detecting efficiency for two radioisotopes can only be obtained by employing two different types of detectors, one sensitive to β and the other sensitive to γ rays. A method based on this principle, using a well-type sodium iodide crystal scintillation counter and a liquid G-M counter (type M6), is described. The samples to be assayed are obtained by wet-ashing the plant material in concentrated perchloric and nitric acids. Ten-ml aliquots are then counted in the G-M counter and 5-ml aliquots (using plastic sample tubes) in the scintillation counter long enough to ensure a statistical accuracy of 1%. The applicability of this method was tested by mixing ^{32}P with ^{65}Zn in various proportions. The results indicated

a marked agreement for both isotopes, between the true and the calculated counting rates. In almost all instances the differences were of the order of 1% and in only one instance a difference as large as 3% was obtained. The advantage of this method is not only the high efficiency with which each isotope is detected, but also the detection of low activities of one isotope in the presence of high activities of the other. Furthermore, the only equipment required is that normally available in an isotope lab. The method is also directly applicable to mixtures of ^{32}P and other γ-emitting isotopes, such as ^{54}Mn, ^{59}Fe, and ^{60}Co. (TCO)

42445 LIQUID-LIQUID EXTRACTION OF URANIUM(VI) WITH MESITYL OXIDE AS AN EXTRACTING AGENT. Khopkar, S. M. (Indian Inst. of Tech., Bombay). Sci. Cult., 30: 191(1964).

Sexavalent U in 6N-HNO_3 containing ≈15% of $NaNO_3$ (as salting-out agent) was extracted into mesityl oxide. The organic solution was evaporated to dryness with HNO_3 and $HClO_4$, and U was determined either gravimetrically as the 8-hydoxyquinolinate or colorimetrically. Quantitative extraction was obtained. (Analytical Abstr., Vol. 12, Aug. 1965)

42446 THERMAL NEUTRON ACTIVATION ANALYSIS OF V AND Mn IN GINSENG USING 3.76-MINUTE ^{52}V AND 2.58-HOUR ^{56}Mn. Lee, Chong-jin; Kim, Chong-kuk; Park, Jin-ha. Ta Han Hua Hsueh Hui-Chih, 7: 13-16(Mar. 1963). (In Korean).

Thermal neutron activation analysis was applied to determine the trace amounts of V and Mn in buyo and Kumsam [Chin Hills] ginseng. These elements are considered to have great nutritional value as well as to be one of the indispensable factors in the growth of ginseng. The TRIGA MARK II reactor was used as the neutron source. The samples were irradiated for 10 min for V and 5 min for Mn at a neutron flux of about 1.28×10^{12} n/cm/sec, and the RCL 256-channel pulse height analyzer connected to a 2- × 2-in. crystal was used for the activity determination. The amounts in a 1-g sample were about 0.02 ppm for V and 20 ppm for Mn, and it was also found that the amounts of the elements were slightly different depending on the kinds of ginsengs. (OID)

42447 THE DETERMINATION OF GOLD IN ASSAY PROCESS BY THERMAL NEUTRON ACTIVATION ANALYSIS. Kim, J. I.; Kim, C. K.; Chang, W. P. Ta Han Hua Hsueh Hui-Chih, 7: 165-9(June 1963). (In Korean).

The possibility of using neutron activation analysis instead of the conventional method for routine Au assay was studied. Qualitative and quantitative trial tests carried out on 12 samples chosen from the strategic points in the process are described. The TRIGA MARK II nuclear reactor and the RCL 256-channel pulse height analyzer were used. Recoveries of ^{198}Au ranged from 81.0 to 93.6%. Results of repeated determinations were reproducible. Hence, it was concluded that this method offered a quantitative and precise determination and localization of Au losses occurring in the given pyro-assay procedure. (OID)

42448 ACTIVATION ANALYSIS WITH A NEUTRON GENERATOR. Mines Branch Research Report R 155. Dibbs, Hugh P. Ottawa, Queen's Printer and Controller of Stationery, 1965. 91p. $1.25.

Available by mail from the Queen's Printer, Ottawa and Canadian Government Bookshops, Ottawa, Toronto, and Montreal.

An account is given of an activation analysis system using a neutron generator as a neutron source. The shielding requirements for high-energy neutrons and the experimental irradiation facilities are described. Activation yields were calculated, under defined conditions, for all stable nuclides that on irradiation with 14-Mev neutrons or with thermal neutrons produce gamma-emitting isotopes. Experimental measurements were also made to determine the sensitivity of detection of sixty-six elements. The gamma spectra resulting from a number of these empirical determinations are presented. (auth)

42449 AVTOMATICHESKIE ANALIZATORY SOSTAVA RADIOKHIMICHESKIKH SRED. (Automatic Analyzers of the Composition of Radiochemical Media). Shelemin, A. V. Moscow, Atomizdat, 1965. 295p.

The construction and performance of automatic analyzers for radiochemical processes is reviewed. A brief description is given of the technological processes of reactor fuel reprocessing and the design of automatic control systems for these processes. Instruments for determining the activity of hydrogen ions and the composition of solutions are described as well as densimeters, automatic polarographs, coulometers, luminescence meters and spectrophotometers, mass spectrometers, nuclear paramagnetic resonance spectrometers, and chromatographs. (R.V.J.)

42450 MEASUREMENT OF HYDROGEN IN HYDROCARBONS BY SLOW NEUTRON TRANSMISSION. Mott, William E.; Rhodes, Donald F. (Gulf Research and Development Co., Pittsburgh). 6p. (CONF-650602-58). Gmelin, AED-CONF-65-125-3.

From American Nuclear Society, 11th Annual Meeting, Gatlinburg, Tenn.

A slow neutron transmission method was used for routinely determining the hydrogen content of hydrocarbons. Equipment consists of a Pu-Be neutron source which emits 1.9×10^7 neutrons per second, a sample cell through which a beam of slow neutrons is directed, and a BF_3 or He^3 end-window proportional counter for measuring the neutron transmission. The apparatus is operated submerged in water which acts as a neutron moderator and constant temperature bath. In determining the hydrogen concentration of an unknown, the density is measured at the transmission cell temperature by means of a pycnometer or a gamma-ray density gage. Results are tabulated. (P.C.H.)

42451 ZINC AND BROMINE IN SOME METEORITES BY NEUTRON ACTIVATION ANALYSIS. Filby, R. H.; Ball, T. K. (Universitet, Oslo). 11p. (CONF-650405-19). Gmelin, AED-CONF-65-040-27.

From International Conference on Modern Trends in Activation Analysis, College Station, Tex.

Zinc and bromine were determined in 30 meteorites by neutron activation analysis. Possible variations of the $^{68}Zn/^{64}Zn$ and $^{81}Br/^{79}Br$ ratios in 2 meteorites relative to the terrestrial ratios were also investigated. The activation method is described. Agreement between chemical and activation values for zinc in chondrites was found to be very good. On the other hand, the results for bromine were very poor. Data are tabulated. (P.C.H.)

42452 CENTRIFUGE. Scheffel, Rudolf; Zippe, Gernot; Steenbeck, Max (to Deutsche Gold- und Silber-Scheideanstalt). Canadian Patent 708,484. Apr. 27, 1965. Priority date Nov. 14, 1957, Germany.

The centrifuge described, running in vacuo, is intended to separate gas mixtures. Self-stabilization of the rotor is achieved by making it flexible rather than rigid. The damping members which absorb the fast vibrations are inside the rotor. The lighter gas portion because of its smaller inertia is collected through a central opening while the heavier portion moves to the periphery. Smaller power requirement, structures of lighter weight, and minimum protection against exploding rotors, are some advantages claimed. (F.S.A.)

42453 CENTRIFUGES, e.g. ULTRACENTRIFUGES FOR THE SEPARATION OF GASES. Los, Johannes; Kelling, Fridjof E. T. (to Reactor Centrum Nederland). Canadian Patent 710,184. May 25, 1965. Priority date Mar. 17, 1960, Netherlands.

An ultracentrifuge is described for separation of gas mixtures or gaseous mixtures of isotopes. The advantage lies in the simplicity of the production of a gas whirl tranversely directed to the axis of rotation. (F.S.A.)

Inorganic and Physical Chemistry

Refer also to abstracts 43241 and 43271.

42454 (BM-RI-6649) A STUDY OF THE CHLORINATION KINETICS OF GERMANIUM, SILICON, IRON, TUNG-

STEN, MOLYBDENUM, COLUMBIUM, AND TANTALUM. Landsberg, Arne; Block, Frank E. (Bureau of Mines, Albany, Oreg. Albany Metallurgy Research Center). Oct, 1964. 27p. Bureau of Mines Free.

A study of the chlorination kinetics of germanium, silicon, iron, tungsten, molybdenum, niobium, and tantalum was made to determine the effects of temperature, chlorine concentration, geometric surface area, and gamma radiation. The reaction products were volatile at the temperatures used thus making it possible to follow the reaction rates by weight loss of the solid. Chlorination rates of germanium, silicon, and iron were found to be directly proportional to chlorine concentration while the rates for tungsten, molybdenum, niobium, and tantalum were proportional to the 0.5 to 0.6 power of chlorine concentration. A good correlation of reaction rate and geometric surface areas was not obtained because the true surface area of the samples could not be measured. Intense gamma radiation had no effect on reaction rates. The Arrhenius activation energies determined over the temperatures used are as follows: Germanium, 27 kcal/mole (233–241°C); silicon, 33 kcal/mole (375–517°C); iron, cold rolled, 20 kcal/mole (259–325°C) annealed, 21 kcal/mole (293–337°C); tungsten, 43 kcal/mole (617–776°C); molybdenum, 37 kcal/mole (445–491°C); niobium, 34 kcal/mole (229–255°C); and tantalum, 29 kcal/mole (370–449°C). Mechanisms are proposed for the germanium, silicon, and iron chlorinations. Self heating of the solids and diffusion control in the gas phase were noted at higher reaction rates. (auth)

42455 (HW–83235) DEVELOPMENT OF FLUIDIZED BED CHLORINATION FOR CONVERTING PuO_2 TO $PuCl_3$. Brandt, H. L. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). July 10, 1964. Contract AT(45-1)-1350. 20p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

A mechanically stirred fluidized bed for converting plutonium dioxide to plutonium chloride with phosgene was developed. Mechanical stirring of the solid phase is required to prevent agglomeration and consequent channeling of the gas through the bed. A continuous reactor may be designed for top feed and bottom removal of product, or vice versa. On the basis of incomplete evidence, top feed is preferred. Semi-continuous operation has been demonstrated with incremental top feed addition and product removal. A typical continuous run with bottom feed demonstrated 72 percent conversion of PuO_2 to $PuCl_3$ at 185 grams plutonium/hour in a one-stage 2 in. × 10 in. reactor. Temperature was 455°C and phosgene gas flow 480 grams/hour. Residence time averaged about 3.2 hours for continuous runs. With semi-continuous operation in the same reactor with top feed, 95 percent conversion at 150 grams plutonium/hour was demonstrated. Product purity was sufficiently high to provide feed for an electrowinning process. The powder flows readily and can be conveyed with a screw with good reliability. Corrosion was negligible in reactors made from Hastelloy and glass. (auth)

42456 (IS-T-20) REACTIONS OF 1, 10-PHENANTHROLINE WITH HYDROGEN, CADMIUM AND ZINC IONS (thesis). Fahsel, Michael John (Ames Lab., Iowa State Univ. of Science and Tech.). July 1965. Contract W-7405-eng-82. 114p. Dep. mn; CFSTI $4.00 cy, $0.75 mn.

The reaction between hydrogen ion and 1,10-phenanthroline, P, was studied. The experimental work indicates that in relatively high concentrations of 1,10-phenanthroline not only does the well documented mono(1,10-phenanthroline) hydrogen(I) species form but also the higher order species, bis(1,10-phenanthroline) hydrogen(I) and tris(1,10-phenanthroline) hydrogen(I). The overall formation constants of these three species were determined potentiometrically. The second order Ag/AgP_2NO_3 electrode developed by Grimes was used to determine the concentration of uncombined 1,10-phenanthroline. The overall conditional formation constants were calculated using the computational formation function, $\bar{n}$, and a weighted least squares computer program on an IBM 7074 computer. The overall stoichiometric formation constants for the hydrogen ion and 1,10-phenanthroline species were obtained by correcting the conditional constants for the competing bisulfate ion reaction. The metal ion and 1,10-phenanthroline stoichiometric constants were obtained from the conditional constants by correcting for the metal acetate and sulfate complexes and the hydrogen ion and 1,10-phenanthroline species. The average values for the overall stoichiometric formation constants were: for H, $\log \beta_1 = 5.11$, $\log \beta_2 = 7.22$, and $\log \beta_3 = 9.03$; for Cd, $\log \beta_1 = 5.91$, $\log \beta_2 = 10.70$, and $\log \beta_3 = 14.93$; for Zn, $\log \beta_1 = 6.36$, $\log \beta_2 = 12.14$, and $\log \beta_3 = 17.14$. The solubility of 1,10-phenanthroline as a function of the total concentration of hydrochloric acid in an aqueous medium was determined. The plot of solubility vs total concentration of hydrochloric acid was linear with a slope of 2.23. The $\bar{n}$ function was rearranged to a form which predicted this linear relationship. From the previously determined overall formation constants for the hydrogen ion and 1,10-phenanthroline species, one is able to calculate a value for the slope of the solubility plot. The calculated value for the slope was 2.23. A possible structure for the hydrogen ion-1,10-phenanthroline species, HP_n^{+1}, is suggested. It is derived from the well documented trihydrated hydronium ion, $H_9O_4^{+1}$ or $H_3O^{+1}(H_2O)_3$, which consists of a pyramidal hydronium ion that is hydrated by three water molecules in the primary hydration sphere and an undetermined number of water molecules in the secondary hydration sphere. It is proposed that in high concentrations of 1,10-phenanthroline, 1,10-phenanthroline competes with and replaces some of the water molecules in the secondary hydration sphere about the hydronium ion. The HP_n^{+1} species would then be represented by $HP_n^{+1} = nP \cdot H_9O_4^{+1}$. (auth)

42457 (NIJS-R–453) RELAXATION THROUGH ANISOTROPIC CHEMICAL SHIFT IN POLYCRYSTALLINE UF_6. Blinc, R.; Pirkmajer, E.; Zupancic, I.; Rigny, P. (Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia)). May 1965. 4p. Dep. mn.

Measurements were made of the field and temperature dependence of the fluorine spin-lattice relaxation times in UF_6. They show that the fluorine motion responsible for fluorine exchange between equatorial and axial sites also dominates the spin-lattice relaxation above 0°C. The mean shielding anisotropy was found to agree with values found from NMR spectra. (D.L.C.)

42458 (NP–15162) ZUR KENNTNIS DER PHOSPHATE DER CERITERDEN. (Knowledge of the Phosphates of the Cerite Earths). Henschel, Heinrich. [1963]. 57p. Dep. mn.

The phosphates of the cerite earths ($PrPO_4$, $NdPO_4$, $SmPO_4$, $EuPO_4$, and $GdPO_4$) all crystallize in two modifications: a hexagonal α modification that was stabilized by 0 to 0.5 formula units of water per formula unit and which changes, on heating between 400 and 800°, irreversibly into the water-free monoclinic β modification. In the high-temperature modification, some strong lines of the hexagonal structure appear weakly which suggests that at 1000° the transition into the β modification is still not completely quantitative. The crystal lattice constants dependent on the ion radius decrease with increasing atomic weight and show clearly the lanthanide contraction. The isotopy of the cerite earth phosphates with the actinide(III) phosphates is remarkable, which is a criterion for the validity of the actinide concept established by Seaborg. (tr-auth)

42459 (RPI–1044-7) PROJECT ON ANISOTROPIC DIFFUSION AND ELECTROMIGRATION. Annual Report, December 1, 1964–November 30, 1965. Huntington, H. B. (Rensselaer Polytechnic Inst., Troy, N. Y.). July 1965. Contract AT(30-1)-1044. 14p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

In the electromigration studies, a small Soret effect was observed in Na but not in Zr. Other electromigration studies include Ag, transition metals, Co, Cu, and Na–K. Problems of temperature measurement are considered. Preliminary results are reported for diffusion of Fe and Hg into Zn, and other anisotropic diffusion studies are also discussed. (D.L.C.)

42460 (SC-R-65-930(Vol.1)) PHYSICAL PROPERTIES OF FUSED SALT MIXTURES. Data from Open Literature, 1907–1962. Clark, Paul V. (Sandia Corp., Albuquerque, N. Mex.). June 15, 1965. Contract AT(29-1)-789. 294p. Dep. mn; CFSTI $7.00 cy, $1.50 mn.

An extensive literature survey was carried out to collect and tabulate data on fused salt mixtures. The data consist of eutectic compositions and melting points in the form of two complementary tables, arranged according to fused salt systems and eutectic melting points. A bibliography of 3754 references and a coordinate index are included. (D.L.C.)

42461 (SC-R-65-956) TIME RESOLVED MASS SPECTROMETRY WITH THE BENDIX TOF MASS SPECTROMETER. Meyer, R. T.; Freese, J. M. (Sandia Corp., Albuquerque, N. Mex.). July 1965. Contract AT(29-1)-789. 9p. (CONF-650519-2). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From 13th Annual Conference of American Society of Testing Materials, St. Louis, Mo.

Adaptation of the mass spectrometric technique to kinetic analyses of transient chemical processes has been limited by low sensitivity for the detection of intermediate species, by long transit paths between the high pressure reaction zone and the low pressure ionization zone, and, in the case of flash photolysis experiments, by a low photochemical conversion efficiency. The present work provided greatly improved performance of a Bendix TOF mass spectrometer for ion generation, transmission, and detection. An ultimate single cycle sensitivity of 1 part in 100,000 was obtained for pulsed operation at 20 kc. This corresponds typically to an absolute abundance of a reactive species of 0.5×10^{-7} mole/liter. Bimolecular reactions with rate constants approaching 10^{11} liter $mole^{-1}$ sec^{-1} may be studied with this sensitivity and time resolution. A short transit path of 2 mm is achieved with a reaction vessel fitted into the Bendix ion source and containing a conical, ground glass sampling orifice. Geometrical coupling of the flash lamp and the reaction vessel permitted efficient transfer of the ultraviolet radiation to the absorbing gases. An incident light flux of 3×10^{18} quanta/cm^2 for the wavelength band 2000 to 4000 Å was measured by nitrogen dioxide actinometry. (auth)

42462 ALKALINE, THALLOUS, AND ALKALINE EARTH URANATES AND HYPO-URANATES. Prigent, Jacques; Lucas, Jacques (Faculte des Sciences, Rennes, France). Bull. Soc. Chim. France, No. 4, 1129-31(Apr. 1965). (In French).

The alkali metal uranates and Tl(I) uranates known at the present time are tabulated. The alkaline earth uranates known are discussed. The preparation of these compounds is reviewed. The structures of $CaUO_4$, $BaUO_4$, $MgUO_4$, and Na_2UO_4 are described. The stability of these compounds and their method of decomposition are considered. The halogen substitutes of the uranates are indicated. The preparation and reduction of the hypouranates are described. (J.S.R.)

42463 COMBINATIONS OF THE RARE EARTH OXIDES WITH THE TRANSITION METAL OXIDES. Bertaut, E. F.; Buisson, G.; Durif, A.; Mareschal, J.; Montmory, M. C.; Quezel-Ambrunaz, S. (CNRS, Grenoble, France; CEN-G, Grenoble, France). Bull. Soc. Chim. France, No. 4, 1132-7(Apr. 1965). (In French).

Studies on the synthesis of compounds formed by the oxides of the conventional transition metals and of the rare earths are described. The synthesis of perovskites, ferrimagnetic garnets, pyrochlores, hexagonal ferroelectric manganites ($MnTO_3$), orthorhombic manganites (TMn_2O_5), and zircons are described in succession. (J.S.R.)

42464 STRUCTURES AND PROPERTIES OF COMPOUNDS FORMED BY THE RARE EARTH OXIDES WITH THE OXIDES OF THE IV-A ELEMENTS. Collongues, M. Robert; Queyroux, Francine; Perez, Monique; Jorba, Y.; Gilles, Jean-Claude (CNRS, Vitry-sur-Seine, France). Bull. Soc. Chim. France, No. 4, 1141-9(Apr. 1965). (In France).

Systems MO_2–$M_2^{III}O_3$ where MO_2 = ZrO_2 or TiO_2 and $M_2^{III}O_3$ = the rare earth oxides were studied in the range between 0 and 50 mole % $M_2^{III}O_3$. Some data, however, are given on phases appearing in the systems studied for $M_2^{III}O_3$ concentrations higher than 50 mole %. It is shown that the structures of the phases detected in the systems are those of the different oxynitrides found in the Zr–O–N system. (J.S.R.)

42465 FLUORITE-RELATED HOMOLOGOUS SERIES IN THE RARE EARTH OXIDES. Sawyer, J. O.; Hyde, Bruce G.; Eyring, Leroy (Arizona State Univ., Tempe). Bull. Soc. Chim. France, No. 4, 1190-9(Apr. 1965).

X-ray-powder diffraction studies were made on PrO_x. The samples were annealed at low temperatures in order to ensure stability of the ordered phases. The results were characterized by the complex x-ray-powder patterns of five distinct intermediate phases. The phases detected were Pr_7O_{12}, Pr_9O_{16}, Pr_9O_{16} + $Pr_{10}O_{18}$, $Pr_{10}O_{18}$, and $Pr_{12}O_{22}$. A preliminary attempt was made to index the patterns of $Pr_{12}O_{22}$ and Pr_9O_{16} as superstructures based on a fluorite subcell. (J.S.R.)

42466 TRIPHENYLPHOSPHINE OXIDE COMPLEXES OF SOME LANTHANIDES. Cousins, D. R.; Hart, F. A. (Queen Mary Coll., London). Chem. Ind. (London), No. 28, 1259(July 10, 1965).

A table is given showing the melting point, molecular weight, and equivalent conductance of the following complexes as well-crystalline solids: $Nd(NO_3)_3(OPPh_3)_3$ (I), $Sm(NO_3)_3(OPPh_3)_3$ (II), $Nd(NO_3)_3(OPPh_3)_2EtOH$ (III), $Sm(NO_3)_3(OPPh_3)_2EtOH$ (IV), $Sm(NCS)_3(OPPh_3)_4$ (V), $Sm(NCS)_3(OPPh_3)_3$ (VI), $SmCl_3(OPPh_3)_4$ (VII), $NdCl_3$-$(OPPh_3)_3$ (VIII), and $SmCl_3(OPPh_3)_3$ (IX). Also isolated were all the complexes $M(NO_3)_3(OPPh_3)_2EtOH$ where M = Y and all lanthanides except Pm; their decomposition points, solubilities, and ir spectra are closely similar. With the exception of III and IV the compounds are soluble in organic solvents and crystallize unchanged from ethanol or acetone but all are decomposed by water; they were mostly purified by recrystallization from ethanol. The compounds show moderately high thermal stability; the existence of two stable types of complex in the case of each different anion is also noteworthy, but compound V dissociates into VI in chloroform as shown by the apparent molecular weight (685) of V in chloroform and by the isolation of VI from this solution. The ir spectra of the complexes (Nujol or hexachlorobutadiene mulls) show the P-O stretching frequency lowered from the Ph_3PO value of 1195 cm^{-1} by about 50 cm^{-1} because of coordination. The replacement of the nitrate ion band at ca 1380 cm^{-1} by two at ca 1450 and ca 1300 cm^{-1} in all the nitrate complexes shows covalently-bound nitrate in agreement with the nonconductance in acetone of compounds I and II. Compounds VIII and IX are clearly six-coordinate lanthanide complexes in contrast to the high coordination numbers which recent studies indicate are normally adopted by these large ions. Sharp-line proton NMR spectra were obtained from deuterochloroform solutions of the complexes I and II. (BBB)

42467 SYSTEMS FORMED BETWEEN CALCIUM SELENIDE AND THE RARE EARTH SELENIDES L_2Se_3. Golabi, Sayed Medhi; Flahaut, Jean; Domange, Louis (Faculte de Pharmacie, Paris). Compt. Rend., 260: 6385-8(June 14, 1965). (In French).

The regions of homogeneity, formed from the NaCl cubic-type selenide, CaSe, by the addition of the rare earth selenides L_2Se_3 (where L = Gd to Lu and Y), were determined. These regions showed first a NaCl-type structure, then a cubic superstructure with parameter twice that of the preceding lattice, and finally a rhombohedric deformation of the superstructure. These three structures were established one after the other without discontinuity when the concentration of rare earth increased. (tr-auth)

42468 STUDY OF SOLIDIFICATION POINTS OF THE OXIDES AND CHROMITES OF THE RARE EARTHS. Foëx, Marc (Centre National de la Recherche Scientifique, Montlouis, France). Compt. Rend., 260: 6389-92 (June 14, 1965). (In French).

From the measurements made, the solidification points of the sesquioxides of the rare earths, R_2O_3, lie between 2300 and 2435°C. Lanthanum chromite, $LaCrO_3$, solidified near 2500°C; the other rare earth chromites were less refractory higher in the series. (tr-auth)

42469 DETERMINATION OF THE COEFFICIENT OF THERMAL CONDUCTIVITY OF HEAVY WATER IN THE LIQUID PHASE, UP TO THE CRITICAL TEMPERATURE. Le Neindre, Bernard; Johannin, Pierre; Vodar, Boris (CNRS, Bellevue, France; Universite, Brest, France). Compt. Rend., 261: 67-70(July 5, 1965). (In French).

An experimental study was made of the coefficient of thermal conductivity of heavy water with an isotopic purity of 99.75%, between 40°C and the critical temperature at pressures between the saturating pressure and 900 bars. The method of coaxial cylinders was used. (tr-auth)

42470 FORMATION OF ZIRCONIUM NITRIDE DURING THE PASSAGE OF A CONTINUOUS CURRENT AT 1300 deg C IN ZIRCONIA STABILIZED WITH YTTRIUM OXIDE. Loup, Jean-Pierre; Mihailovic, Zivko; Morvan, Pierre (CEN, Saclay). Compt. Rend., 261: 109-12 (July 5, 1965). (In French).

The ionic electric conductivity of $ZrO_2-10\%\ Y_2O_3$ was determined between 850 and 1300°C. The passage of a continuous current in this material, at 1300°C, provoked electrolysis in air. The formation of black zirconia and zirconium nitride was established. The presence of these compounds limited the electrolysis and ZrN caused a cracking of the ceramic. (tr-auth)

42471 HIGH-TEMPERATURE STUDY OF THE ALLOTROPIC TRANSFORMATIONS OF GADOLINIUM SESQUIOXIDE. Foëx, Marc; Traverse, Jean-Pierre (CNRS, Montlouis, France). Compt. Rend., 261: 149-52(July 5, 1965). (In French).

Studies of gadolinium sesquioxide by thermal analysis and high-temperature x-ray diffraction showed changes of the crystalline form near 2200°C; the monoclinic form changed to the hexagonal. Another transformation at a temperature (2360°C) very near the fusion point was detected by these methods. (tr-auth)

42472 HEATS OF IMMERSION OF URANIUM OXIDES IN n-NITROPROPANE. [PART] III. Kolar, D.; Brcic, B. S. (Nuclear Inst. Jozef Stefan, Ljublijana, Yugoslavia). Croat. Chem. Acta, 37: 37-40(1965).

Heats of wetting of uranium oxides with different O/U ratios were measured in n-nitropropane and these heats were found to decrease with increasing oxygen content of the oxides. This behavior was compared with the opposite tendency in water. It was concluded that a definite amount of UO_3 is relatively easily formed on the surface of UO_2 at lower temperatures. (auth)

42473 TEMPERATURE DEPENDENCY OF ABSORPTIVITY AND QUENCHING OF URANYL COMPOUND FLUORESCENCE. Umreiko, D. S. (Belorussian State Univ., USSR). Dokl. Akad. Nauk BSSR, 9: 221-3(Apr. 1965). (In Russian)

Absorption of light in the visible range by uranyl compounds is attributed to at most 3 excited states of the uranyl ion. The spectra due to the various transition processes possess different temperature dependences; this causes differences in the spectra of uranyl salts in solutions, glass, and minerals. This problem was investigated by comparing the temperature dependence of the absorption spectra and the quantum yield of the fluorescence of organic uranyl compounds that do not exhibit luminescence at room temperature. The spectra were nearly continuous in the visible range; their integral absorption was much larger than that of inorganic solutions at the same temperature. A lowering of the temperature resulted in the reduction of the absorption coefficient with a simultaneous increase in the luminescence yield. The behavior of these solutions may be explained by assuming that a predissociation involving the interaction of 2 excited electronic states of the uranyl ions takes place. One of these is a lower state, characterized by a large number of discrete values of the fully symmetric valence oscillations of the UO^{2+} ion, controlling the absorption in the visible range up to 350 mμ, while the other is a nonquantum state, characterizing the absorption in the ultraviolet range. The temperature quenching of uranyl compounds may also be due to the presence of the fluorescing state of other, higher electron states of the uranyl ion in the visible range of the spectrum. (TTT)

42474 ELECTROLYTIC REDUCTION OF URANIUM (VI) AND PLUTONIUM(IV) NITRATE SOLUTIONS: DEVELOPMENT OF A CONTINUOUS PROCESS. Finlayson, M. B.; Mowat, J. A. S. (Dounreay Experimental Reactor Establishment, Caithness, Scotland). Electrochem. Technol., 3: 148-54(May-June 1965).

Electrolytic reduction of uranyl to uranous ion in nitric acid solution was studied in static and flowing systems using mercury and solid metal cathodes, including tantalum, niobium, aluminum, stainless steel, and amalgamated copper. Tantalum cathodes proved to be the most satisfactory. Uranyl nitrate was pumped through a series of seven cells, using tantalum cathodes, with cathodic current densities decreasing from cell to cell, and 99.8% reduction of U(IV) was achieved. Mixed plutonium/uranyl nitrate solutions were reduced to Pu(III)-U(IV) in a static system with a current efficiency of 95%. (auth)

42475 COMPLEXES OF TRIVALENT LANTHANIDE AND ACTINIDE IONS. I. OUTER-SPHERE ION PAIRS. Choppin, Gregory R.; Strazik, William F. (Florida State Univ., Tallahassee). Inorg. Chem., 4: 1250-4(Sept. 1965).

Stability constants were measured for the mononitrato complexes of Ce(III), Pm(III), EuIII), Tb(III), Tm(III), and Am(III) by a solvent-extraction technique. These stability constants as well as the enthalpy and entropy data for MNO_3^{2+} indicated that these are outer-sphere ion pairs. It was proposed that these data could be interpreted in terms of a general model of lanthanide complexing in which the effect on the hydration sphere about the cation is the dominant effect. (auth)

42476 COMPLEXES OF TRIVALENT LANTHANIDE AND ACTINIDE IONS. II. INNER-SPHERE COMPLEXES. Choppin, Gregory R.; Graffeo, Anthony J. (Florida State Univ., Tallahassee). Inorg. Chem., 4: 1254-7(Sept. 1965).

The stability constants and thermodynamic parameters for the first and second steps in the formation of the lanthanide propionate and isobutyrate complexes were determined at 25.0°C and an ionic strength of 2.00M $NaClO_4$. The stability constants were obtained by direct pH titrations and the enthalpy changes by calorimetric titrations. An interpretation of the data is offered in terms of the effect of complexing on the hydration sphere about the cation. (auth)

42477 FORMATION OF XENON DIFLUORIDE FROM XENON AND OXYGEN DIFLUORIDE OR FLUORINE IN PYREX GLASS AT ROOM TEMPERATURE. Streng, L. V.; Streng, A. G. (Temple Univ., Philadelphia). Inorg. Chem., 4: 1370-1(Sept. 1965).

Formation of xenon difluoride from xenon and oxygen difluoride or fluorine was found to occur in a Pyrex glass flask at room temperature and atmospheric pressure when exposed to ordinary daylight. The XeF_2 crystals grew to a size of 3 to 5 mm. The initial rate of formation was about 35 mg/day. The total amount of product obtained in 3 weeks varied from 0.5 to 0.75 g. There was no reaction in darkness. (F.J.H.)

42478 QUENCHING OF THE SCINTILLATION PROCESS IN PLASTICS BY OXYGEN. Sandler, S. R. (Border Chemical Co., Philadelphia). Intern. J. Appl. Radiation Isotopes, 16: 473-7(Aug. 1965).

Spectral evidence was obtained to indicate that fluorescence quenching by air in polyvinyltoluene scintillators is probably produced by oxidation products containing the carbonyl group. The evidence for the chemical nature of the quencher was obtained indirectly by demonstrating that analogous carbonyl compounds cause a similar shift in the fluorescence spectra and produce quenching when incorporated in polyvinyltoluene scintillators. The lower order of magnitude of quenching by air in liquid scintillation solvents at room temperature was due in part to the absence of oxidation products. (auth)

42479 LABELED OXYGEN DIFLUORIDE—$^{17,18}O$. Reinhard, R. R.; Arkell A. (Texaco Research Center, Beacon, N. Y.). Intern. J. Appl. Radiation Isotopes, 16: 498-9(Aug. 1965).

Synthesis of OF_2 samples containing up to 90% ^{18}O and 11% ^{17}O was carried out by the electrolysis of hydrogen fluoride containing up to 0.5% of the appropriately enriched water. The procedure is described. The OF_2 isotopic products were analyzed by gas and infrared chromatography. (F.J.H.)

42480 ISOTOPIC THERMAL-DIFFUSION FACTOR FOR XENON. Paul, R.; Howard, A. J.; Watson, W. W. (Yale Univ., New Haven). J. Chem. Phys., 43: 1890-4 (Sept. 15, 1965).

The isotopic thermal-diffusion factor α_0 for xenon was determined over a mean temperature range of 245 to 543°K. An artificial mixture of xenon isotopes containing approximately 18% ^{129}Xe and 15% ^{136}Xe was subjected to thermal diffusion in a 10-tube swing separator; the isotopic thermal-diffusion factor was obtained from the change of concentrations of these two isotopes only. A best-fitting procedure yields potential parameters $\alpha = 16$ and $\epsilon/k = 257$°K for the exponential-six interaction-potential model, whereas the Lennard-Jones (12 : 6) model fails to reproduce the experimental results. This exp-6 potential was then used to calculate the values of diffusion, viscosity, thermal conductivity, and second virial coefficient, and a reasonably good agreement was obtained with $r_m = 4.41$ Å. An intercomparison of the observed and theoretically calculated isotopic thermal-diffusion factors for all the inert gases from $T^* = 0.6$ to 60 is also presented. (auth)

42481 ION-MOLECULE REACTIONS IN HYDROGEN–RARE-GAS MIXTURES. Aquilanti, V.; Galli, A.; Giardini-Guidoni, A.; Volpi, G. G. (C.N.E.N., Rome; Universita, Rome). J. Chem. Phys., 43: 1969-73(Sept. 15, 1965).

Ion-molecule reactions in rare-gas-hydrogen systems were studied by high-pressure mass spectrometry, using a specially designed ion source which employs the beta rays of tritium as ionizing medium. The rate constants for reactions of H_3^+ with rare gases and of rare-gas ions with hydrogen were measured. The results are in qualitative agreement with radiolysis experiments on hydrogen-deuterium exchange, and if a quantitative comparison is attempted, it is possible to estimate the rate constant of the chain-propagation reaction. Experiments are also reported for N_2-H_2 and O_2-H_2 mixtures. (auth)

42482 MOBILITIES OF CESIUM AND RUBIDIUM IONS IN THEIR PARENT VAPORS. Lee, Yuan-tseh; Mahan, Bruce H. (Univ. of California, Berkeley). J. Chem. Phys., 43: 2016-19(Sept. 15, 1965). (UCRL-16230).

The mobilities of Rb^+ and Rb_2^+ in rubidium vapor, and of Cs^+ and Cs_2^+ in cesium vapor were measured. The mobilities of the molecular ions agree well with values calculated from the Langevin theory in its polarization limit. The mobilities of the atomic ions are consistent with the predictions of simple resonant charge transfer theory. Rate constants for the reactions of the atomic ions with diatomic molecules to give diatomic molecular ions were obtained. (auth)

42483 RAMAN INTENSITIES OF HDO AND STRUCTURE IN LIQUID WATER. Wall, Theodore T.; Hornig, Donald F. (Princeton Univ., N. J.). J. Chem. Phys., 43: 2079-87(Sept. 15, 1965).

Photoelectric Raman spectra of HDO in 5-mole % isotopically substituted water show single, broad, slightly asymmetric bands in both of the regions containing the uncoupled fundamental stretching motions. An empirical correlation between O–H or O–D stretching frequency and O···O hydrogen-bonded distance was used to map the frequency coordinate of the spectra onto an intermolecular distance scale, and the Raman bands are replotted on this abscissa. The resulting intermolecular distribution functions for liquid water agree with x-ray results and support the suggestion that the breadth of the HDO uncoupled stretching bands reflects the variation of intermolecular distance. Moreover, it is noted that the corresponding infrared and Raman bonds are almost superposable, and that this indicates little hydrogen-bond breakage in liquid water. The distribution of intermolecular distances represented by the spectra was compared to that incorporated in some of the structural models for liquid water. It appears that a successful model should incorporate the homogeneity, isotropy, coherence, and disorder of the liquid in its local structure. (auth)

42484 TETRACARBIDE MOLECULES IN THE VAPOR PHASE OVER RARE-EARTH–GRAPHITE SYSTEMS. Balducci, G.; Capalbi, A.; De Maria, G.; Guido, M. (Universita, Rome). J. Chem. Phys., 43: 2136-7(Sept. 15, 1965).

During a mass spectrometric study of some rare earth-carbon systems at high temperature, it was possible to identify unambiguously gaseous dicarbides, and also tetracarbide molecules of high stability over the cerium-graphite and holmium-graphite systems. The PrC_4 molecule was tentatively identified over the praseodymium-graphite system. Temperatures ranged from 1900 to 2450°C. Typical relative ion intensities measured at 17 ev and 2273°K for Ce, CeC_2, and CeC_4 were $1 : 7.7 \times 10^{-1} : 1.8 \times 10^{-2}$; for Pr, PrC_2, and PrC_4, $1 : 1.2 \times 10^{-1} : 10^{-3}$ at 2150°K; and for Ho, HoC_2, and HoC_4, $1 : 4 \times 10^{-3} : 6 \times 10^{-5}$ at 2360°K. Thermodynamic properties of the rare earths and gaseous carbides were calculated. (P.C.H.)

42485 REACTIVE SCATTERING IN MOLECULAR BEAMS: ELECTRIC-DEFLECTION ANALYSIS OF ROTATIONAL EXCITATION OF PRODUCTS. Herm, R. R.; Herschbach, D. R. (Harvard Univ., Cambridge, Mass.). J. Chem. Phys., 43: 2139-40(Sept. 15, 1965).

In order to determine separately the part due to rotational excitation in reactive scattering reactions, the deflection suffered by MX molecules as they traverse a strong inhomogeneous electric field was determined. Since rotation produces a gyroscopic quenching of the Stark effect, the rotational energy may be evaluated from the breadth of the deflection pattern and its variation with field strength (if the distribution of transit times is known from velocity analysis). Examples are given for reactively scattered KBr and CsBr, for elastic scattering of K from cyclohexane (at $\theta = 30$°C, open diamonds), and for thermal beams (at $\theta = 0$°C) of K, Cs, and CsCl. The results demonstrated that in these reactions the mean rotational excitation of the newly formed products is comparable to the thermal energy. (P.C.H.)

42486 DISCONTINUOUS CHANGE OF BINDING TYPE IN THE SERIES OF MONOHYDRIDES. III. REGULARITIES AND IRREGULARITIES OF INTERNUCLEAR DISTANCES AND FORCE CONSTANTS. Fajans, Kasimir (Univ. of Michigan, Ann Arbor). J. Chem. Phys., 43: 2159-62(Oct. 1, 1965).

The recently attempted correlation of internuclear distances of the monohydrides of all elements by linear plots of logr vs logZ (atomic number) for each of the two octaves and of the three long periods is not satisfactory. The equations $r_e = 2.2240\ n^{-0.426}$ and $r_0 = 2.7793\ n^{-0.371}$ (n is the total number of valence electrons in the hydride) apply merely from HF to BH and from HCl to AlH, respectively. The marked deviations from these equations shown by the hydrides M(I)H and M(II)H are related to a discontinuous change of binding type. In the long periods, r increases for the hydrides of the heavy metals from M(I)H to M(III)H, due to the decrease of polarizability and penetrability of the cations with an 18-electron ($s^2p^6d^{10}$) outer shell, e.g., from AgH to InH. It is emphasized that the knowledge of spectroscopic data for molecule ions of the hydrides of long period elements is necessary in order to decide at which places discontinuous changes of binding type occur. (auth)

42487 TWO-DIMENSIONAL SECOND VIRIAL COEFFICIENTS OF METHANE AND TETRADEUTEROMETHANE ON GRAPHITIC CARBON. Sams, John R. (Univ. of British Columbia, Vancouver). J. Chem. Phys., 43: 2243-50(Oct. 1, 1965).

Specific two-dimensional second virial coefficients were

obtained from low-coverage adsorption isotherms for CH_4 and CD_4 on graphitic carbon between 220 and 290°K. The data are analyzed in terms of both classical and quantum-statistical models employing a Lennard-Jones potential, and corrections for nonplanarity of the adsorbed phase are also included. The sign of the quantity $[\epsilon(H) - \epsilon(D)]/\epsilon(D)$ cannot be unambiguously determined, but this quantity is somewhat smaller than in the corresponding three-dimensional case. The measured nonadditivity of pair potentials amounts to about 15% of the gas-phase energy, and is in good agreement with independent theoretical predictions. (auth)

42488 DIFFUSION THEORY OF NONEQUILIBRIUM DISSOCIATION AND RECOMBINATION. Keck, James (Avco-Everett Research Lab., Everett, Mass.); Carrier, George. J. Chem. Phys., 43: 2284-98(Oct. 1, 1965).

The coupled vibration-dissociation-recombination process for molecules and atoms was examined. Techniques for solving the appropriate master equations for both quantum (discrete) and classical (continuous) models are given. It is shown that the process is most easily treated classically and that in this case the master equation can be reduced to an equivalent diffusion equation. It is assumed that, after an initial vibration transient, during which reactions are negligible, the process may be treated using the steady-state approximation. During the steady-state phase, the usual phenomenological rate equations are valid and the ratio of the forward and reverse rate constants is the equilibrium constant, though the individual rate constants are depressed below their equilibrium values. Comparison of the results with other theoretical work shows general agreement for similar models; comparison with shock-tube experiments on molecular dissociation and stellarator experiments on ionic recombination is encouraging. (auth)

42489 FLAME-PHOTOMETRIC DETERMINATION OF THE DISSOCIATION ENERGIES OF THE ALKALINE-EARTH OXIDES. Kalff, P. J.; Hollander, T.J.; Alkemade, C. Th. J. (Rijksuniversteit, Utrecht). J. Chem. Phys., 43: 2299-2307(Oct. 1, 1965).

Two independent methods for determining dissociation energies of CaO, SrO, and BaO from optical measurements of band and line intensities in CO–air flames are described. The emitter of the measured bands has been shown not to be hydroxide molecules or molecules containing more than one metal atom. From a comparison of the results for both methods it was concluded that the value of the electronic partition function of the alkaline-earth oxide molecule is around 6. Recommended values for the dissociation energies are (in electron volts): 3.96 ± 0.06, 4.11 ± 0.06, and 5.00 ± 0.10 for CaO, SrO, and BaO, respectively. A comparison with the literature data is given. (auth)

42490 THEORY OF SATURATION AND DOUBLE-RESONANCE EFFECTS IN ESR SPECTRA. Freed, Jack H. (Cornell Univ., Ithaca, N. Y.). J. Chem. Phys., 43: 2312-32(Oct. 1, 1965).

A theory of saturation in the electron spin resonance spectra of dilute solutions of free radicals was developed in terms of the general Boltzmann equation for the density matrix given by Bloch and Redfield. It is shown, in contrast to the earlier theories, that, in general, a composite line arising from a set of degenerate nuclear spin states must be described by a generalized (matrix) saturated Lorentzian rather than a single line of over-all saturated Lorentzian shape. The general properties of this solution are discussed in detail for the case when electron-nuclear dipolar interactions are the only important nuclear-spin-dependent relaxation mechanism. A particularly simple situation exists when similar nuclei are completely equivalent. Then each composite line consists of a superposition of saturated Lorentzians, and the linewidths and saturation parameters of each component depend only on the values of the total spin and of the z component of spin of the associated configuration of the completely equivalent nuclei. Thus it would be possible to saturate some components to a greater extent than others. In the absence of saturation the present theory reduces to the linewidth theory of Freed and Fraenkel. Detailed expressions are obtained for steady-state electron-nuclear double-resonance (ENDOR) effects on radicals containing completely equivalent sets of nuclei. The saturating fields can lead to coherence and induced-transition effects. It is shown how the latter, under appropriate conditions, can result in enhancement of saturated ESR spectra. It appears necessary for enhancements that lattice-induced nuclear spin transitions should be comparable in magnitude to the lattice-induced electron spin transitions, or else cross transitions involving both nuclear and electron spins must be important in the relaxation process. A brief discussion of enhancement by a transient heating effect is also given. (P.C.H.)

42491 PROTON DYNAMICS IN HYDROGEN-BONDED FERROELECTRICS. Imry, Y.; Pelah, I.; Wiener, E. (Israel Atomic Energy Commission, Yavne). J. Chem. Phys., 43: 2332-40(Oct. 1, 1965).

A comparison between infrared absorption and neutron inelastic-scattering measurements indicates the existence of a broad low-energy (around 400 cm^{-1}) protonic level in KH_2PO_4 above the Curie point. This level is only weakly discerned in the ir but is seen quite clearly in neutron scattering. The mode is explained as resulting from splitting of the ground level of the proton in a slightly asymmetric double minimum potential well where tunneling of the proton takes place. The asymmetry is caused by the interaction between the different protons, and it changes slowly with time as the result of the collective motions of the protons. Prominent changes in ir spectra in the 400-cm^{-1} range were found on cooling through the Curie point, indicating the disappearance of the tunneling mode. This picture allows a simplified treatment of the system, leading to the existence of two correlated phase transition points, and a negative thermal expansion coefficient of the H bond at temperatures between these points. The two transition points are identified as the Curie point and the melting or dissociation point of the crystal. The theory also suggests an increase in the dielectric constant as the melting point is approached, corresponding to the Curie-Weiss behavior as the Curie point is approached. (auth)

42492 MEASUREMENT OF THE DENSITY OF SATURATED CESIUM VAPOR BY AN OPTICAL METHOD. Rozwadowski, M.; Lipworth, E. (Brandeis Univ., Waltham, Mass.). J. Chem. Phys., 43: 2347-50(Oct. 1, 1965).

The vapor pressure of cesium metal was measured as a function of temperature using a scanning Fabry–Perot interferometer. The apparatus was constructed to measure cesium-vapor densities in optical pumping experiments. In clean, evacuated glass bulbs the vapor pressure of pure cesium metal is in close agreement with the results of Langmuir and Taylor. The vapor pressure is lowered considerably if rubidium metal is mixed with the cesium. (auth)

42493 DETERMINATION OF ELECTRONIC SYMMETRY BY ELECTRIC DEFLECTION: LiO AND LaO. Berg, Robert A. (Harvard Univ., Cambridge, Mass.); Wharton, Lennard; Klemperer, William; Buechler, Alfred; Stauffer, James L. J. Chem. Phys., 43: 2416-21(Oct. 1, 1965).

The focusing, by means of an electrostatic quadrupole, of polar molecules with first- or second-order Stark effects is discussed. Indications of molecular electronic symmetry may be obtained from quantitative measurements of the intensity of refocusing of beams of diatomic molecules. Such measurements indicate that the ground state of LiO is Π while that of LaO is Σ. It is suggested that the optical spectroscopic data of ScO, YO, and LaO are best explained by assigning the ground states of these three molecules as $^2\Sigma$. The observed low-lying electronic states of these molecules are interpreted in terms of a localized-orbital picture. (auth)

42494 MOLECULAR STRUCTURE OF XeF_6. Bartell, L. S. (Ames Lab., Ames, Iowa); Gavin, R. M. Jr.; Thompson, H. Bradford; Chernick, C. L. J. Chem. Phys., 43: 2547-8(Oct. 1, 1965). (IS–1220).

An electron-diffraction analysis was made on the structure of gaseous XeF_6. Preliminary diffraction data ($11 \leq$

$q \leq 124$) imply an average Xe-F bond length of $r_g = 1.90 \pm 0.01$ Å, which is consistent with the trend set by XeF_4 and XeF_2. However, the molecule is appreciably distorted from O_h symmetry. The results confirmed the inference that gaseous XeF_6 is not a regular octahedron. (P.C.H.)

42495 GROUND STATES AND HYPERFINE-STRUCTURE SEPARATIONS OF ScO, YO, AND LaO FROM ESR SPECTRA AT 4 deg K. Kasai, Paul H.; Weltner, William Jr. (Union Carbide Research Inst., Tarrytown, N. Y.). J. Chem. Phys., 43: 2553(Oct. 1, 1965).

Conclusive evidence is given to show that the molecules ScO, YO, and LaO all have $^2\Sigma$ ground states and that the splittings in the optical spectra are derived from magnetic hyperfine interaction. The hyperfine-structure separations, $\Delta\nu$, were found to be ScO, 0.268; YO, 0.027; and LaO, 0.519 cm^{-1}. The splittings observed in the optical spectra of the gases were 0.21 cm^{-1} for ScO, 0.48 cm^{-1} for LaO, and undetectably small for YO. Extrapolation to less-polarizable matrices indicated that the $\Delta\nu$ values will decrease to yield better agreement with the observed splittings in the optical spectra of the gases. (P.C.H.)

42496 ISOTOPE EFFECT IN THE PHOTOIONIZATION EFFICIENCY FOR BENZENE. Person, James C. (Argonne National Lab., Ill.). J. Chem. Phys., 43: 2553-5 (Oct. 1, 1965).

The theoretical conclusion that an isotope effect exists in photoionization was tested for both C_6H_6 and C_6D_6. A comparison of values of the absorption cross sections, σ_H and σ_D showed shifts in the positions of the absorption maxima, and the average absorption at each photon energy seemed to be about 3% less for C_6D_6 than for C_6H_6. The average value of the isotope efficiency, η_D/η_H, was 1.07 to 1.08, when the ratio was evaluated at each energy. It is illustrated that any average of η_D will be greater than the average of η_H, so that the predicted isotope effect was observed. (P.C.H.)

42497 EQUILIBRIUM CONSTANT FOR THE DEUTERIUM EXCHANGE BETWEEN METHYLACETYLENE AND WATER. Mahadevan, E. G. (Columbia Univ., New York); Monse, E. U. J. Chem. Phys., 43: 2558-9(Oct. 1, 1965).

Deuterium exchange between methylacetylene gas and liquid water according to the reaction $CH_3C \equiv CH(g) + HDO(l) \rightleftharpoons CH_3C \equiv CD(g) + H_2O(l)$ was investigated to evaluate the usefulness of this system for concentrating deuterium in a dual-temperature process. Within the experimental error of about ±6% the agreement of observed and calculated values of equilibrium constant, K_1 was satisfactory at 25°C. The observed increase of K_1 between 25 and 80°C of nearly 20% disagreed with the calculated increase of K_1, which was about 5%. (P.C.H.)

42498 REACTIONS OF AQUEOUS THORIUM NITRATE SOLUTIONS WITH HYDROGEN PEROXIDE. Johnson, G. L.; Kelly, M. J.; Cuneo, D. R. (Oak Ridge National Lab., Tenn.). J. Inorg. Nucl. Chem., 27: 1787-91(Aug. 1965). (ORNL-P-373).

Thorium peroxynitrate was prepared by the action of hydrogen peroxide on acidified thorium nitrate solutions. From analyses of solid samples and from a study of the stoichiometry of solutions, the stoichiometric composition of the thorium peroxynitrate was found to be $Th_6(OO)_{10}(NO_3)_4 \cdot 10H_2O$. Peroxy bridges are believed included in an undetermined polymeric structure. The stability of the compound was studied and compared with the stability of uranium peroxide and hydrogen peroxide. (auth)

42499 AN OPTICAL STUDY OF LITHIUM AND LITHIUM-OXYGEN COMPLEXES AS DONOR IMPURITIES IN SILICON. Gilmer, T. E. Jr.; Franks, R. K.; Bell, R. J. (Virginia Polytechnic Inst., Blacksburg). J. Phys. Chem. Solids, 26: 1195-1204(Aug. 1965).

Infrared absorption spectra were determined for lithium-doped, single-crystal silicon samples in the energy range from 23.0 to 45.0 Mev. A series of resonant absorptions corresponding to a donor ionization energy of 32.5 Mev was found in oxygen-free silicon; it was concluded that this series was due to the monatomic lithium donor. Samples originally containing some oxygen showed a series of resonant absorptions corresponding to a donor ionization energy of 39.2 Mev. This was attributed to LiO. The complexity of the spectra obtained increased with increasing oxygen content, presumably due to absorption in other lithium-oxygen complexes. (auth)

42500 PARAMAGNETIC RESONANCE OF Gd^{3+} IN ThO_2 SINGLE CRYSTALS. Abraham, M. M.; Lee, E. J.; Weeks, R. A. (Oak Ridge National Lab., Tenn.). J. Phys. Chem. Solids, 26: 1249-54(Aug. 1965). (ORNL-P-1052)

The paramagnetic resonance of Gd^{3+} substituted into the tetravalent Th sites of ThO_2 at 77, 20, 4, and ~2°K was studied. Observations showed the predominant spectra to be due to a cubic crystal field indicating that the necessary charge compensation is remote. The variation of the spectra with temperature was consistent with negative values for the fourth and sixth order parameters in the cubic crystal field spin Hamiltonian. The separation between the outer lines of the spectra for H parallel to [100] as a function of temperature was compared with Gd^{3+} in an axial crystal field $[La(C_2H_5SO_4)_3 \cdot 9H_2O]$. Good resolution of the hyperfine structure permitted evaluation of the ratio $A_{155}/A_{157} = 0.7634 \pm 0.002$. (auth)

42501 ENERGY TRANSFER FROM UO_2^{2+} TO Er^{3+} IN GLASS. Kitamura, Akio (Matshushita Communication Industrial Co. Ltd., Yokohama, Japan). J. Phys. Soc. Japan, 20: 1283-4(July 1965).

Energy transfer from UO_2^{2+} to Er^{3+} in silicate glass was observed. Evidence for the energy transfer is given by a comparison of the excitation spectra for Er^{3+} 1.6 μ emission and of the emission decay time of UO_2^{2+}. As is clearly shown, broad additional excitation bands around 420 mμ and $\lambda < 350$ mμ appear in the coactivated sample. Although the UO_2^{2+} emission decay curve is found to be not exponential in those glass hosts, the shortening of the decay time is very clear. Measurements of the excitation spectra for this emission show that the reverse energy transfer does not occur. The average transfer distance was estimated to be about 10 Å. (J.F.P.)

42502 CHANGES IN THERMODYNAMIC PROPERTIES DURING ALLOTROPIC PHASE TRANSITIONS. Rolov, B. N. (Latvian State Univ., USSR). Latvijas PSR Zinatnu Akad. Vestis, Fiz. Tek. Zinatnu Ser., No. 3, 27-34(1965). (In Russian).

Phase transitions between two crystalline modifications were studied. The change of internal energy U was calculated using the Debye approximation. Numeric results were obtained for transitions from the cubic system to the hexagonal one. (auth)

42503 PREPARATION OF TETRAHYDROFURAN COMPOUNDS OF RARE EARTH CHLORIDES. Rossmanith, K.; Auer-Welsbach, C. (Universitaet, Vienna). Monatsh. Chem., 96: 602-5(1965). (In German).

The anhydrous chlorides of the rare earth elements formed stable crystalline compounds with tetrahydrofuran (THF). The following compounds were prepared: $MeCl_3 \cdot 1.4$ to 1.5 THF (Me = La, Ce), $MeCl_3 \cdot 2$THF (Me = Pr, Nd, Sm, Gd), $MeCl_3 \cdot 3.3$ to 3.6 THF (Me = Dy, Ho, Er, Y), and $YbCl_3 \cdot 2.9$THF. Their solubilities in THF were determined. Two different curves were obtained, corresponding to different compositions of the solid phases in equilibrium with the solutions. (auth)

42504 THE DECOMPOSITION STEPS OF TETRAHYDROFURAN COMPOUNDS OF THE RARE EARTH CHLORIDES. Rossmanith, K.; Auer-Welsbach, C. (Universitaet, Vienna). Monatsh. Chem., 96: 606-13 (1965). (In German).

The isothermally determined degradation steps of the compounds of the chlorides of the rare earths with tetrahydrofuran (THF) corresponded to the grouping that was found from their composition and solubilities in THF. The compounds of the composition $MeCl_3 \cdot 2$THF gave an intermediate $MeCl_3 \cdot 0.5$THF, the compounds $MeCl_3 \cdot 3.3$ to 3.6THF formed the intermediate phases $MeCl_3 \cdot$ THF and $MeCl_3 \cdot 0.5$THF. The adducts of La, Ce, and Yb did not correspond to this generalization. The vapor pressures

above $PrCl_3 \cdot 2THF$ and $NdCl_3 \cdot 2THF$ were determined at different temperatures, and the corresponding enthalpies of decomposition were calculated. Heating in a high vacuum completely removed all THF except from the Yb compounds. (auth)

42505 OBTAINING LOW-POROSITY SAMPLES OF TITANIUM AND ZIRCONIUM HYDRIDES BY THE REACTION SINTERING METHOD. Antonova, M. M. Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 7, 25-33(July 1965). (In Russian).

The conditions for obtaining low-porosity samples of titanium and zirconium hydrides by the reaction sintering method were investigated. It was established that as a result of reaction sintering low-porosity samples of titanium hydride with a density up to 2.95 g/cm³ (residual porosity 23 to 24%, hydrogen content up to 63 at.%), and zirconium hydride with a density up to 4.35 g/cm³ (residual porosity 21%, hydrogen content up to 66.3 at.%) can be obtained. (auth)

42506 KINETIC ENERGY OF FRAGMENT IONS IN A RADIOFREQUENCY MASS SPECTROMETER. Green, J. H.; Ryan, K. R. (Univ. of New South Wales, Sydney). Proc. Roy. Soc. (London), Ser. A, 286: 178-90(June 22, 1965).

A radiofrequency mass spectrometer was used, with slight modification, to measure the kinetic energy of fragment ions from polyatomic molecules. Selected ions from CO_2, CH_3OH, C_2H_5OH, C_3H_7OH, $i\text{-}C_3H_7OH$, CH_3I and C_2H_5I were examined for excess kinetic energy by means of retarding potential analysis before mass analysis. The excess kinetic energy for any given ions was always greater for 70 v electron impacts than for 50 v. Such ions as m/q 31 and 29 from ethanol have an excess of about 0.45 v kinetic energy for 50 and 70 v electrons; m/q 29 and 27 from isopropanol also have about 0.45 excess energy for 70 v electrons; CH_3^+ ions from the alcohols and from the iodides showed excess kinetic energy while m/q 27 from ethyl iodide had 0.9 v excess energy for 70 v electrons. The results are interpreted as evidence of a significant number of dissociations from electronic states that are not in effective competition with one another. The existence of noncompeting dissociation paths for a given molecular ion complex would preclude the application of the statistical theory of mass spectra to predict the breakdown scheme of that complex. (auth)

42507 THE THERMAL EXPANSION OF ALKALI HALIDES AT LOW TEMPERATURES. White, G. K. (CSIRO, Sydney). Proc. Roy. Soc. (London), Ser. A, 286: 204-17(June 22, 1965).

Linear thermal expansions of eight alkali halides have been determined at liquid oxygen temperatures and at temperatures from 30 down to 2°K. For temperatures $T \leq \theta/20$, where θ is the Debye temperature, the expansion coefficients are well represented by $\alpha = AT^3 + BT^5$. Values are reported for the Grüneisen parameter $\gamma = 3\alpha V/C\chi$, where C/V is the heat capacity per unit volume and χ is the compressibility. For CsBr (bcc structure) γ appears to be nearly independent of temperature, with a value of 2.0; but for the other crystals, which have the rock-salt structure, the parameter γ varies with temperature, chiefly between $\theta/10$ and $\theta/5$. At room temperature, γ lies between 1.45 and 1.7, but a low temperature this generally decreases to a value γ_0 which is ca. −0.1 for RbI, +0.3 for KCl, KBr and KI, and 1.0 for NaCl and NaI; LiF does not show this decrease, γ_0 being 1.7. The values observed for γ_0 are compared with those calculated from elastic constants, and their pressure derivatives and the general behavior of $\gamma(T)$ is observed to conform qualitatively to the predictions of simple theoretical models of Born, Blackman and Barron. (auth)

42508 PROCESSES AND PRODUCTS OF THE INTERACTION OF THE HIGH MOLECULAR COMPOUNDS WITH INORGANIC SALTS. V. PHYSICAL-CHEMICAL INVESTIGATION OF THE INTERACTION PROCESSES OF POLYACROLEIN WITH INORGANIC SALTS. Andreeva, I. V.; Rogozina, E. M.; Andreev, P. F. Radiokhimiya, 7: 83-90 (1965). (In Russian).

The processes and products of the interaction of polyacrolein in dissolved and solid states with uranyl and thorium salts was investigated by conductometric, potentiometric, polarographic, and infrared spectral methods. The formation of coordination complexes of the carbonyl group of polyacronein with uranyl and thorium salts was established. With uranyl salts, water-soluble polyacronein formed a concealing complex. (tr-auth)

42509 THE CRYSTAL STRUCTURE AND OPTICAL PROPERTIES OF EUROPIUM CHLORIDE HEXAHYDRATE, $EuCl_3 \cdot 6H_2O$. Bel'skii, N. K.; Struchkov, Yu. T. (Inst. of Heteroorganic Compounds, Academy of Sciences, USSR). Soviet Phys.-Cryst. (English Transl.), 10: 15-20(July-Aug. 1965).

Translated from Kristallografiya, 10: 21-8(Jan.-Feb. 1965).

A complete x-ray structural study of crystals of europium chloride hexahydrate was carried out. They are monoclinic class, a = 9.67, b = 6.52, c = 7.99 A, β = 94°36', N = 2, and space group P2/n. The structure consists of the "complex" ions $[Eu^{3+}(H_2O)_6Cl_2]^+$ and "isolated" Cl^- ions. The cations and anions occupy special positions on the diad axes. All the shortest distances in the structure correspond to the sums of ionic radii or to hydrogen bonds between water molecules. In the visible region of the spectrum, the dispersion of the three principal refractive indices was measured. For the sodium-D line, $n_g = 1.5815$, $n_m = 1.5784$, and $n_p = 1.5702$. The angle of the optical axes is 69°. The directions of the absorption magnetic and electrical dipoles and the axes of the indicatrices of the refractive indices were determined relative to the axes of the unit cell. The positions of the atoms in the unit cell were determined. (auth)

42510 X-RAY STRUCTURAL PHASE ANALYSIS OF THE SCANDIUM–HYDROGEN SYSTEM. Azarkh, Z. M.; Funin, V. N. Soviet Phys.-Cryst. (English Transl.), 10: 21-3(July-Aug. 1965).

Translated from Kristallografiya, 10: 29-31(Jan.-Feb. 1965).

Phase transitions in scandium hydrides were studied. The 99.8% pure metallic scandium was saturated with hydrogen up to a hydrogen: metal atomic ratio of 2 : 1. The material was subjected to x-ray powder analysis. Photographs corresponding to hydrogen contents of 10, 20, and 28 at.% showed a gradual increase in the hexagonal lattice constants. When the absorption rose to 30 at.%, the first lines belonging to the cubic β phase appeared. At higher hydrogen concentrations the lines of the hexagonal phase gradually disappeared and those of the cubic phase became stronger. Within the range of hydrogen content investigated (67 at.%) scandium did not show any tetragonal deformation of the β-phase unit cell. (M.C.G.)

42511 ISOMER SHIFT IN ^{151}Eu. Huefner, S.; Kienle, P.; Quitmann, D.; Brix, P. (Technische Hochschule, Darmstadt, Ger.). Z. Physik, 187: 67-84(1965). (In German).

The isomer shift of the 21.7-kev gamma transition in ^{151}Eu was studied for various divalent and trivalent europium compounds using the Mössbauer technique. The gamma energy is lower by up to 1.1×10^{-6} ev in divalent compounds than in trivalent compounds. Using data from atomic spectroscopy, it is estimated that the electron density at the nucleus is larger by about 1.9×10^{26} cm^{-3} for the configuration $4f^6$ than for $4f^7$ due to different shielding of the s^2 shells. The difference of the mean square radii of the 21.7-kev state and the ground state is then $\delta\langle r^2\rangle = +0.03$ fm². The measured isomer shift between trivalent and metallic europium and the relative s-electron densities in the rare earth metals measured by the positron annihilation rates are used to establish a calibration scheme for isomer shifts in rare earth metals. This calibration scheme is used to deduce a change $\delta\langle r^2\rangle = +0.005_5$ fm² between the 26-kev state and the ground state of ^{161}Dy. (auth)

42512 CHLOROBROMIDE COMPLEX TETRAACIDIC TYPE URANYL COMPOUNDS. Ellert, G. V.; Tsapkin, V. V.; Mikhailov, Yu. N.; Kuznetsov, V. G. Zh. Neorgan. Khim., 10: 1572-80(July 1965). (In Russian).

Six compounds of the genetic series $Me_2(UO_2H_4)$, where Me = Cs^+ and H = Br^- and Cl^-, were prepared and investigated using physical-chemical methods (molecular electron conductivity, thermogravimetry, and crystal optical measurements). It was possible to synthesize two compounds with the composition $Cs_2(UO_2Cl_2Br_2)$, different in their physical and chemical properties (color, indices of refraction, and value I-d on x-ray powder diagrams). X-radiographic measurements confirmed the individuality of all synthesized compounds and led to the hypothesis on the conversion of the cubic form of $Cs_2(UO_2Cl_2Br_2)$ to the trans configuration and of the needle form of $Cs_2(UO_2Cl_2Br_2)$ to the cis configuration. (tr-auth)

42513 VACUUM-THERMAL PREPARATION OF RARE-EARTH SILICIDE METALS. Dvorina, L. A.; Verkhoglyadova, T. S. Zh. Neorgan. Khim., 10: 1598-1602(July 1965). (In Russian).

Preparation of Sc, Y, La, and Ce disilicides by silicon reduction in a vacuum using oxides (Sc_2O_3, Y_2O_3, La_2O_3 and CeO_2) annealed at 1200°K and high-purity (99.9%) silicon polycrystals. Homogeneous silicide phases of Sc, Y, La, and Ce were obtained after aging for 2 hr in a vacuum (10^{-4} to 10^{-5} mm Hg) at 1700 to 1800°K. (R.V.J.)

42514 SYNTHESIS OF SODIUM YTTERBATE. Murav'eva, I. A.; Kovba, L. M.; Martynenko, L. I.; Spitsyn, Vikt. I. (Moscow State Univ.). Zh. Neorgan. Khim., 10: 1756-7 (July 1965). (In Russian).

Mixtures of ytterbium oxide and sodium oxide with ratios of Yb : Na = 1 : 2 and 1 : 3 were treated with nitric acid in corundum crucibles. After separating nitric oxide the dried precipitate was calcinated in a crucible oven at 850°C for 6 hours. X-ray diffraction studies of the prepared sodium ytterbate identified a hexagonal configuration. The lattice parameters were a = 3.350 ± 0.01 and c = 16.53 ± 0.01 Å. (R.V.J.)

42515 REACTION OF ALIPHATIC AMINE CHLOROHYDRATES WITH SAMARIUM CHLORIDE IN PRESENCE OF ETHYL ALCOHOL. Sakharov, N. N.; Avdeev, V. P. (Saratov State Univ., USSR). Zh. Obshch. Khim., 35: 1171-3(July 1965). (In Russian).

Preparation and properties of four binary samarium chloride trimethylamine chlorohydrates ($SmCl_3 \cdot x(CH_3)_3N \cdot HCl$), where x is 1, 2, 3, and 4, and five binary chloride dimethylamine chlorohydrates $SmCl \cdot x_3(CH_3)_2NH \cdot HCl$), H_2O (with x = 1, 2, 3, 6, and 7) are described. (R.V.J.)

42516 CRYSTALLINE YTTRIUM HYDROXYCHLORIDE. Klevtsov, P. V.; Klevtsova, P. F.; Sheina, L. P. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Zh. Strukt. Khim., 6: 469-71(May-June 1965). (In Russian).

The chemical composition of yttrium hydroxychloride $Y(OH)_2Cl$ garnet-structured crystals formed by hydrothermal synthesis of yttrium iron ferrite in $FeCl_3$, $FeCl_2$, NH_4Cl, and other chloride aqueous solutions was studied. Crystallographic characteristics and symmetry of $Y(OH)_2Cl$ monocrystals were analyzed. (R.V.J.)

42517 EXCHANGE EQUILIBRIA ON THE SURFACE OF IONIC CRYSTALS. Lieser, K. H. (Technische Hochschule, Darmstadt, Ger.). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-64/12, 21p. (CONF-650549-8). ORINS.

From IAEA Symposium on Exchange Reactions, Upton, N. Y.

Experimental data obtained by tracer techniques are presented and discussed. The number of exchanging cations and anions per unit area on the surface of $BaSO_4$ and $SrSO_4$ was measured for equivalent particles, cationic particles, and anionic particles. Equivalent particles obtained by washing the precipitates thoroughly with water showed equal amounts of exchanging cations and anions per unit area of the surface. For cationic particles and anionic particles obtained by treatment of the precipitates with solutions containing barium (strontium) ions or sulfate ions respectively, the ratio of the numbers of exchanging cations and anions was >1 (cationic particles) or <1 (anionic particles). From the values obtained the number of potential determining ions on the surface was determined. In the case of $SrSO_4$ the number of exchanging cations and anions per unit area of the surface was measured as a function of temperature. They were found to decrease rapidly below 40°C in water solutions. This was explained by immobilization of the water molecules on special points of the surface (in cracks for instance) proceeding gradually on approaching the freezing point. In agreement with this explanation the immobilization started at lower temperatures for water-methanol mixtures. The exchange equilibria between different cations were measured on the surface of the alkaline earth carbonates and sulfates and on the surface of the alkali tetraphenylborates. The equilibrium constants for these heterogeneous exchange reactions are discussed. In general these equilibria show the same trend as the solubilities. Barium ions, for instance, were enriched on the surface of strontium sulfate. The ratio of the solubilities, however, was no measure for these equilibria. The exchange equilibria on the surface of the alkaline earth sulfates showed "ideal" behavior; they were independent of the lattice parameters. (auth)

42518 THE COMBUSTION OF A ZIRCONIUM-INORGANIC OXIDIZER PYROTECHNIC MIXTURE. Williams, Ralph E. (Univ. of Denver). 21p. (CONF-650444-2). Gmelin, AED-CONF-65-119-3.

From Western States Combustion Inst., 1965 Spring Meeting, Hollywood, Calif.

Pyrotechnic mixtures, in pellet form, consisting of zirconium and an inorganic oxidizer were ignited at simulated altitudes up to 100,000 feet in a space environmental chamber. High speed photography and quenching in liquid nitrogen indicated rapid and complete oxidation of the zirconium within five centimeters of the reaction surface at ambient pressures. The transition from cubic ZrO_2 back to monoclinic ZrO_2 was found ten centimeters from the reaction surface. Experiments with a framing camera, capable of 10^6 frames per second, were initiated in an attempt to photograph the fragmentation phenomenon on mixtures containing excess zirconium. (auth)

42519 DIFFUSION OF POINT DEFECTS IN NONSTOICHIOMETRIC OXIDES. Kassner, T. F.; Walters, L. C.; Grace, R. E. (Purdue Univ., Lafayette, Ind.). Vienna, International Atomic Energy Agency, 1965, Preprint No. SM-66/76, 20p. (CONF-650704-26). ORINS.

From IAEA Symposium on Thermodynamics, Vienna.

The defect structure and properties of nonstoichiometric oxides are interrelated by thermodynamic equilibria, which exist at the interfaces between oxides and adjacent phases as well as within oxides themselves. It is shown that diffusive mass transport in nonstoichiometric oxides may be related specifically to the equilibria between oxides and metallic phases, the equilibria between oxides and the vapor phase, and internal equilibria between various crystal defects within the oxide phase. Model equilibria for high-temperature oxidation, diffusion of radioisotopes and crystal defects, and extrinsic electrical conductivity are described in detail for chromic oxide, Cr_2O_3, and strontium titanate, $SrTiO_3$. Experimental measurements of diffusive mass transfer in Cr_2O_3 are shown to be in substantial agreement with predicted thermodynamic equilibria. The kinetics of oxidation of high-purity electrolytic chromium in damp hydrogen were studied using a torsion microbalance. A range of temperatures from 700 to 1000°C and hydrogen dew points from −48 to 23°C was investigated. Damp hydrogen permitted the exploration of oxidizing conditions, which were just perceptibly oxidizing with respect to the over-all equilibrium between Cr, Cr_2O_3, and the vapor phase. Freshly abraded samples with a 4/0 metallographic polish exhibited a brief period of linear oxidation (~20 min) followed by a lengthy period of diffusion-controlled parabolic oxidation (~400 min). The variation of the parabolic rate constant with H_2O/H_2 pressure ratio was found to agree with the pressure dependence predicted for Cr_2O_3 having a defect structure of cation vacancies and electron holes. The results were confirmed by self diffusion studies in single crystals of Cr_2O_3. Crystals and damp hydrogen vapor were equilibrated and ^{51}Cr was used as a tracer. The results showed that the tracer diffusion coefficient varied as the 3/8

power of the H_2O/H_2 pressure ratio according to the following equilibrium between vapor, solid Cr_2O_3, chromium vacancies, $\square$ and electron holes, $\oplus$: $3H_2O(g) = Cr_2O_3 + 2Cr\square^{-3} + 6\oplus + 3H_2(g)$. The analysis was applied to the ternary compound, $SrTiO_3$, and measurements of the electrical conductivity are shown to be useful in determining the type of defect equilibria as well as the transport properties of electrically-active crystal defects. (auth)

42520 METHOD OF DISSOLVING PLUTONIUM WITH SULFAMIC ACID. Jenkins, W. J. (to U. S. Atomic Energy Commission). U. S. Patent 3,208,817. Sept. 28, 1965.

A method for dissolving plutonium metal is presented. The dissolution is effected by immersing the plutonium metal in aqueous sulfamic acid until essentially all of the metal is dissolved. Also, the dissolution of plutonium metal in nitric acid is improved by adding a small amount of sulfamic acid as a synergistic agent and maintaining the dissolution temperature below 50°C. (AEC)

42521 METHOD FOR STABILIZING URANIUM MONOCARBIDE. Stoops, R. F.; Hamme, J. V. (to U. S. Atomic Energy Commission). U. S. Patent 3,208,818. Sept. 28, 1965.

Methods for the preparation of an oxygen-saturated uranium compound of the formula $U(C_{0.75}O_{0.25})$ are presented. (AEC)

Organic Chemistry

42522 EFFECT OF THE SUPPORT ON THE YIELD OF TRITIATION BY EXCHANGE. Cardinaud, Robert; Bouchet, Jean-Claude (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). Bull. Soc. Chim. France, No. 3, 834-43(Mar. 1965). (In French).

Tritiation exchange in heterogeneous systems was studied experimentally by evaluating the reproducibility of such an operation. Inert supports such as quartz showed an evolution of the specific activity proportional to the specific surface. In certain limits of the ratio, weight of the substance/weight of the support, the phenomenon was inverse for activated carbon. The geometry of the surfaces of these supports can account qualitatively for the behavior in which the initial labeling mechanism is caused by $(HeT)^+$ or the β radiation. Comparison of the experimental conditions and of relative values of the products, maleic acid, fumaric acid, and succinic acid, seemed to indicate that fumaric acid and succinic acid have a common precursor and that the carbon exercises more than quartz a steric inhibiting effect on the formation of fumaric acid. Succinic acid was formed preferentially by trans addition inhibited on carbon. (tr-auth)

42523 α-DEUTERIUM KINETIC ISOTOPE EFFECTS IN SOLVOLYSES OF endo-NORBORNYL p-BROMOBENZENESULFONATE. Lee, C. C.; Wong, Edward W. C. (Univ. of Saskatchewan, Saskatoon). Can. J. Chem., 43: 2254-8(Aug. 1965).

endo-Norbornyl-2-d p-bromobenzenesulfonate was synthesized and the isotope effects, as measured by k_H/k_D, were determined over a range of temperatures for solvolyses in 30% water–70% dioxane, acetic acid, and formic acid. Values of k_H/k_D are of the order of 1.20. The data appear to indicate slightly higher isotope effects as the solvents are changed from aqueous dioxane to acetic acid to formic acid, as well as somewhat higher isotope effects at lower temperatures. Possible mechanistic implications of these results are presented. Relative titrimetric acetolysis rates, k_{exo}/k_{endo}, at different temperatures, and enthalpies and entropies of activation for these acetolyses are evaluated and discussed. (auth)

42524 PREPARATION OF NITROALKYL CHLORIDES. Benziger, Theodore M.; Rohwer, Robert K. (to U. S. Atomic Energy Commission). U. S. Patent 3,207,796. Sept. 21, 1965.

A process is described for the preparation of lower nitroalkyl chlorides in which a beta-nitroalcohol is reacted with a sulfuryl chloride in the presence of a tertiary base such as pyridine. (AEC)

Radiation Chemistry

See also BIOLOGY AND MEDICINE — Radiation Effects.

42525 (AGN-8137(Vol.II)) FISSIOCHEMICAL PROCESS DEVELOPMENT PROGRAM. VOLUME II. LOOP OPERATIONS. Final Report, March 1965. Whipple, J. C.; Black, R. H.; Elliott, D. M.; Groff, C. C.; Pearson, R. L. (Aerojet-General Nucleonics, San Ramon, Calif.). Contract AT(04-3)-368. 238p. Dep. mn; CFSTI $6.00 cy, $1.25 mn.

Results of one major phase are reported: the operation of an in-reactor hydrazine production loop, product processing, and the post-operative hot cell examination of the loop. The AGN-6 loop experiment involved the circulation of a slurry of fully enriched particulate UO_2 in liquid ammonia through the high thermal neutron flux region of the Materials Testing Reactor; sampling and removal of the hydrazine product; separation and disposal of the radiolytic gases formed; and liquid ammonia feed makeup. The equipment was operated for one unfueled and three fueled cycles; total operating time was 1440 hours at nominal fission power levels of 0 to 9 kw. Pump seizure, occurring after completion of the unfueled cycle, required a three cycle delay in operations while the pump was replaced and the system modified to prevent recurrence. Many of the other equipment problems encountered were overcome by modification and replacement of components (e.g., valve bellows), demonstrating that such maintenance could be safely accomplished in high radiation fields. The nonfueled loop operations determined the gamma-induced product yields to be $G_{N_2} = 0.50$, $G_{H_2} = 1.50$, and $G_{N_2H_4} = 0.05$, where the G value is defined as the number of molecules produced per 100 ev of energy deposited. The equilibrium product concentration attained was 0.04 wt % hydrazine in ammonia. Initial fueled operations resulted in a hydrazine G value of 1.27 (at zero product concentration), essentially confirming capsule-based predictions. Product concentration rose, with time, to the 1 wt % equilibrium value expected at the existing power level. The subsequent, and unexpected, decline in hydrazine concentration was caused by fuel plate-out on the internal loop surfaces which led to a lowered ratio of fission fragment to gamma energy deposition in the reactant stream. Hydrazine was successfully separated from loop filtrate by distillation and evaporation; decontamination factors of 24,000 were attained, lowering radiation levels to a point where the partially processed product could be finally purified in essentially unshielded conventional equipment. Post-operational loop component inspection revealed no serious corrosion, erosion, or wear problems. While severe slurry fuel behavior problems remain to be solved, none of the equipment problems encountered during operation offered serious obstacles to continued development of the process. (auth)

42526 (TID-22085) ELECTRON PARAMAGNETIC RESONANCE STUDIES OF NEUTRON IRRADIATED SINGLE CRYSTALS OF LITHIUM SULFATE (thesis). Aseltine, Clifford L. (Wayne State Univ., Detroit, Mich.). June 1964. Contract AT(11-1)-1054. 47p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

The isotropic component of the electron paramagnetic resonance absorption of neutron-irradiated lithium sulfate monohydrate and monodeuterate was investigated at controlled temperatures. The absorption is characterized by a positive shift in the spectroscopic g-value from that (2.0023) of a free electron, a Gaussian shape, little dependence of the width on spin concentration, the appearance of lithium metal grains upon annealing, and the change of the observed width for different lithium isotopes. The data are compared with the results of calculations based on several models. The observed data appear to be explained qualitatively in terms of a model consisting of trapped holes which are subjected to hyperfine interactions with the neighboring lithium nuclei. (auth)

42527 (JPRS-31473, pp 81-7) RESEARCH ON THE ROTARY RESONANCE ON ANTI-RADIATION SULPHIDE ELECTRONS. Wen-chuan, Hsin; Min-jen, Yao; Cheng-lien, Chang; Ch'ing-hsin, Hua. Translated from K'o Hsueh T'ung Pao, No. 12, 1105-7(Dec. 17, 1964).

Molecular mixtures of sulfide and amino acid and sulfide and protein were mixed in certain proportions and then exposed to gamma irradiation. Studies were then made on the effects of alanine and cysteine on the wave spectra of the mixtures. The results showed that hydroxy compounds in molecular mixture affect the free radicals of protein and amino acid after radiation; however, no such appreciable effect was found in derived oxides and other compounds not containing sulfide. It was observed that the wave spectra of molecular mixtures of histidine and cysteine obviously transfer into sulfur signals. By prolonging the time the wave spectra of molecular mixtures of cysteine show intensified signals in portions of low magnetic field. In hydroxy compounds and amino acid, the gradual emergence of sulfur signals was observed. Thus, it is believed that in a certain range, the non-coupled electrons of large molecules of amino acid and protein transfer to chemicals containing sulfide, causing the energence of sulfur signals. (P.C.H.)

42528 EFFECTS OF MIXING ON CHAIN REACTIONS IN ISOTHERMAL PHOTOREACTORS. Hill, Frank B.; Felder, Richard M. (Brookhaven National Lab., Upton, N. Y.). A.I.Ch.E. (Am. Inst. Chem. Engrs.) J., 11: 873-85(Sept. 1965). (BNL-8829).

An analytical study of the interaction of mixing, radiation attenuation, and chemical kinetics in isothermal photoreactors is presented. For a particular chain reaction mechanism in the presence of stationary state kinetics and low conversion, the conditions required for the existence of mixing effects are formally stated, and the direction of change of conversion and quantum yield resulting from the introduction of mixing is established. Calculated results are presented for monoenergetic, unidirectional sources. Factors considered include mode of chain termination, radiation attenuation law, photoreactor geometry, state of mixing, and reactor optical thickness. Chemical and mixing time scale considerations are discussed. (auth)

42529 ANALYSIS OF VAPOURISABLE ORGANIC COMPOUNDS FORMED AT γ-IRRADIATION OR PYROLYSIS OF SOME CRYSTAL MODIFICATIONS OF GLUCOSE. Herlitz, Einar; Loefroth, Goeran; Widmark, Gunnar (Univ. of Stockholm). Acta Chem. Scand., 19: 595-600(1965).

Crystalline samples of α-D(+)-glucose, α-D(+)-glucose monohydrate, and β-D(+)-glucose were γ irradiated (^{60}Co, 1.5 to 12.4 Mrad, preferably 6.2 Mrad), or pyrolyzed (175°C, 2hr). After addition of water to the samples, the head space vapors over the solutions were analyzed using a gas chromatograph at its highest sensitivities. The patterns of the chromatograms for irradiated samples varied from those for pyrolyzed samples. Smaller but obvious differences were also found when comparing the six chromatograms with one another, an exception being α-glucose and its hydrate, which after pyrolyses gave the same chromatograms. It was not found possible to identify the small amounts of organic vapors giving the peaks of the chromatograms, nor was the influence of impurities determined. (auth)

42530 EFFECT OF TEMPERATURE ON X-RAY-INDUCED LIGHT EMISSION FROM POWDERS OF AMINO ACIDS AND TRYPSIN. Carter, J. G. (Oak Ridge National Lab., Tenn.); Nelson, D. R.; Augenstein, L. G. Arch. Biochem. Biophys., 11: 270-82(Aug. 1965).

Observations in studies of the effect of temperature on the intensity of x-ray-induced emission from powders of aromatic amino acids and proteins are discussed. The thermal coefficients for quenching of both fluorescence and phosphorescence are much different at temperatures below about 150°K and above 240°K. The ratios of the coefficients measured in the two temperature regions varied from 3 to 50 in the four compounds studied. The E_q for tryptophan fluorescence in powders exposed to x rays near 300°K is much less than the coefficient for quenching ultraviolet-induced fluorescence from tryptophan in solution. The quenching coefficient for fluorescence is invariably smaller than that for phosphorescence. The $E_q = 0.21 \pm .07$ ev per molecule for the quenching of trypsin phosphorescence in the range T > 200°K is essentially the same as that for tyrosine phosphorescence. This value is approximately twice that of 0.1 ev per molecule for the thermal enhancement of trypsin inactivation by ionizing radiations in the same temperature range. Crude measurements suggest that the thermal coefficient for quenching of trypsin fluorescence is also less than the corresponding activation energies for trypsin inactivation. It was concluded that: quenching is a function of the macromolecular organization of proteins; thermal enhancement of enzyme inactivation yields does not depend critically upon indiscriminate quenching to prevent emissive loss of potential inactivating energy from the irradiated molecules, and either the interaction of specific excited aromatic residues with radiosensitive structures does not provide a large contribution to enzyme inactivation or the specific interactions account for only a small fraction of total quenching. The present results emphasize again the differences between the excitation events produced by x-ray-induced electrons and low-energy ultraviolet. Although trypsin fluorescence appears to be from tryptophan, x rays cause a great enhancement in trypsin of phosphorescence typical of that from tyrosine: excitations by ionizing radiations must be involved in intersystem crossing with high probability. Red components not found in ultraviolet-induced emission are also observed. (auth)

42531 ELECTRON PARAMAGNETIC RESONANCE STUDY OF γ-RAY IRRADIATED PHOSPHATE GLASSES. Nakai, Yasuo (Tokyo Shibaura Electric Co., Ltd.). Bull. Chem. Soc. Japan, 38: 1308-13(Aug. 1965).

The EPR spectrum, consisting of a two-line structure and two other distinct types of weak resonances, obtained from irradiated phosphate glasses suggested that these paramagnetic centers are connected with the peculiar structure of phosphate glasses. The two-line structure arises from an axially symmetric hyperfine interaction of a hole with a ^{31}P nucleus. Two distinct types were demonstrated: one is a trapped hole produced in the glass network, and the other is the trapped electron in the alkaline or alkaline earth ion. In phosphate glasses modified with such ions as calcium, barium, or lithium, which can coordinate with the tetrahedral oxygen atom in "End" groups ($-PO_3$), the weak resonances seemed to appear easily. (auth)

42532 REACTIVE FIBER. IV. THE GRAFT COPOLYMERIZATION OF GLYCIDYL METHACRYLATE ONTO POLYPROPYLENE AND POLYVINYL CHLORIDE FIBERS. Iwakura, Yoshio; Kurosaki, Toshikazu; Nagakubo, Kuniharu; Takeda, Kenji; Miura, Masatoshi (Tokyo Univ.; Tokyo Inst. of Tech.; Hitachi Central Research Lab., Tokyo). Bull. Chem. Soc. Japan, 38: 1349-54(Aug. 1965).

The graft polymerization of glycidyl methacrylate onto polypropylene or polyvinyl chloride fiber was carried out by the technique of γ pre-irradiation in vacuo, and reactions of the grafted fiber with amines were investigated. In the case of polypropylene, the addition of benzene or tetrahydrofuran to the monomer remarkably increased the grafting rate. The initial grafting rate was slow in acetone or ethylacetate. The epoxide groups of the grafted polypropylene reacted with diethanolamine quantitatively, but with methyl glucamine partially, with a yield of 70%. In the case of polyvinyl chloride, benzene or acetonitrile was suitable as a grafting solvent. Graft polymerization proceeded in a narrow range of temperature from 10 to 20°C. Diethanolamine or aniline reacted with yields of 50 to 60% with the epoxide groups of the grafted polyvinyl chloride. Polyhydroxyamine-treated graft fibers had a good dyeability for both direct and acid dyes. (auth)

42533 RECOIL REACTIONS IN THE IRRADIATED TRIS-(ETHYLENEDIAMINE)-COBALT(III) COMPLEXES. Saito, Nobufusa; Tominaga, Takeshi; Sano, Hirotoshi (Tokyo Univ.). Bull. Chem. Soc. Japan, 38: 1407-8(Aug. 1965).

The tris-(ethylenediamine)-cobalt(III) complexes were irradiated with slow neutrons for 1 hr at pile temperature

in the presence of air. The irradiated salt was stored for one to three days in dry ice after which it was dissolved in distilled water and the ^{60}Co-labeled species separated by means of paper electrophoresis, ion exchange, precipitation, or recrystallization. Retention generally tended to increase with a decrease in the stability of the outer anion as a ligand. This dependence of the retention value on the stability of the outer anion can be explained by assuming that the outer anions and ligand groups (NH_3, ethylenediamine, or H_2O molecules), more or less ruptured as a result of recoil, compete with each other in the subsequent reactions, during which various ^{60}Co-labeled complexes are formed through the reaction of recoil cobalt atoms with neighboring entities according to their concentrations and stabilities as complexed with cobalt. (F.J.H.)

42534 A VERSATILE RADIATION SOURCE FOR STUDYING GAMMA-INITIATED REACTIONS. Hodgins, J. W.; Werezak, G. N.; Ross, S. L. (McMaster Univ., Hamilton, Ont.). Can. J. Chem. Eng., 43: 117-18(June 1965).

For the investigation of chemical reactions initiated by ionizing radiation, a gamma source was constructed employing ^{60}Co as the emitter. This source is used in a radiation laboratory equipped with manipulators and therefore, has a wide range of applicability. Dose rate, total dosage, and radiation environment can be varied for either batch or flow type experiments. The design and flux characteristics of this source are described. (auth)

42535 THE ELECTRON SPIN RESONANCE SPECTRUM OF $N(CH_3)_3$ IN γ-IRRADIATED BETAINE. Drews, R.; Cadena, D. Jr.; Rowlands, J. Can. J. Chem., 43: 2439-42(Aug. 1965).

The study of effects of γ irradiation on a single crystal of betaine was motivated by the thought that a detailed study of it might help in the further understanding of the radiation chemistry of choline chloride. In the latter no trace of the species $N(CH_3)_3$ was reported but in betaine at room temperature it was the only species observed. In the betaine lattice the radical was found to exhibit a nitrogen hyperfine tensor whose principal values more closely approximate the cylindrical symmetry to be expected from a planar radical. (F.S.A.)

42536 SOLVENT-SENSITIZED ISOMERIZATION OF DIELS-ALDER ADDUCTS OF p-BENZOQUINONE WITH ^{60}Co γ RAYS. Krauch, Carl Heinrich; Metzner, Wolfgang (Max-Planck-Institut fuer Kohlenforschung, Muelheim-Ruhr, Ger.). Chem. Ber., 98: 2106-10(1965). (In German).

The endo Diels-Alder adducts of p-benzoquinones with cyclic 1,3-dienes were isomerized to cage compounds in liquid aromatic solvents by ^{60}Co radiation; the compounds studied were the adducts of cyclopentadiene, cyclohexadiene, dihydro-p-cymene, and cyclooctatetraene. In each case the cage diketones formed photochemically were produced. The solvent acts as sensitizer; irradiation of the cyclohexadiene adduct in acetone at 30°C produced only small amounts of the cage diketone (G = 0.15) compared to the amount formed in benzene at 30°C (G = 1.17) or in toluene at −20°C (G = 0.98). Only tars were produced in cyclohexane. Such data suggest a relay sensitization by aromatic solvents. Diffusion control of the reaction is suggested by the lack of product formed in solid benzene at −20°C. The cyclohexadiene adduct also dimerizes in benzene at −20°C; however, the other adducts exhibit only the formation of cage compound under the conditions specified. For cyclopentadiene adduct, dihydro-p-cymene adduct, and cyclooctatetraene adduct, the yield of cage compounds and G are, respectively: benzene, 30°C, 33%, 39%, 35%; 0.60, 1.04, 0.64; toluene, −20°C, 44%, 51%, 36%; 0.91, 0.89, 0.62, for 1.5–2.5 g/100 ml solvent and $1.5-3 \times 10^{23}$ ev. (BBB)

42537 RADIATION CHEMISTRY FROM A TECHNICAL VIEWPOINT. Roesinger, S. (Farbwerke Hoechst AG, Frankfurt a.M.-Hochst). Chem.-Ingr.-Tech., 37: 128-37 (Feb. 1965). (In German).

The status of technology of radiation chemistry for large scale production of certain chemical products is described. Among inorganic reactions, syntheses of N oxides, N_2H_4, NH_3, and others may prove feasible. The combination of heterogeneous catalysis and radiation chemistry is discussed for several reactions. Several important organic reactions, polymerizations, sulfoxidations, cracking, and semiconductor preparations, were also examined with respect to radiation yields. Radiation oxidations are mentioned; of particular technical interest is the oxidation of benzene to phenol, which has a G value of up to 70. Chlorinations are reviewed, along with sulfoxidations and HBr additions to ethylene. The effects of radiation on polymerization, irradiation of plastics, and graft polymerization are discussed, with tables of commercially useful procedures already investigated. Sterilization and preservation of foodstuffs are discussed, and a note on sources is added. (107 references). (BBB)

42538 RADIOLYSIS IN THE GASEOUS PHASE OF ISOTOPIC MIXTURES OF CYCLOHEXANE IN THE PRESENCE OF NITRIC OXIDE. Milhaud, Jeannine; Durup, Jean (Faculte des Sciences, Orsay, France). Compt. Rend., 260: 6363-6(June 14, 1965). (In French).

Radiolysis of the gaseous mixtures Cy-C_6H_{12} + Cy-C_6D_{12} and Cy-C_6H_{12} + Cy-C_6D_{12} + 2.6% NO was studied. The isotopic composition of the C_1, C_2, and C_3 products showed that the nonsaturated compounds arise principally from unimolecular processes and the saturated compounds from radical reactions. The formation of some isotopic species in the presence of NO showed the role of ion-molecule reactions. (tr-auth)

42539 THE IDENTIFICATION OF THE FREE RADICALS INDUCED BY X RADIATION IN DESOXYRIBONUCLEIC ACID IN THE SOLID PHASE. Van de Vorst, Albert; Richir, Marc (Universite, Liege). Compt. Rend., 260: 6458-61(June 14, 1965). (In French).

The variations of the form of the electron paramagnetic resonance spectrum of degraded DNA was studied as a function of the temperature of irradiation and of observation. It was established that the spectra obtained differ significantly from those of the high-molecular-weight DNA. For example, at room temperature, degraded DNA gave a spectral line characteristic of thymine, whereas a high-weight DNA gave a spectral line analogous to that resulting from the superposition of the signals obtained in guanine and cytosine, taken separately. In each case, the variations of the form of the spectrum with the temperature seemed to lead to an isomerization effect of the free radical. (tr-auth)

42540 EFFECT OF ELECTRONS WITH ENERGY BETWEEN 0.3 AND 1.2 Mev ON DIFFERENT PHOTOGRAPHIC EMULSIONS; CHARACTERISTIC BLACKENING CURVES. Sevely, Jean (CNRS, Toulouse). Compt. Rend., 261: 82-5(July 5, 1965). (In French).

Various photographic plates were exposed to a beam of electrons accelerated under voltages from 300 to 1200 kv. The blackening curves obtained are presented and compared with nuclear emulsions exposed to a current-type emission. (tr-auth)

42541 ROLE OF CRYSTAL TRANSFORMATION IN ANNEALING OF CHEMICAL RADIATION DAMAGE. Mohanty, S. R.; Upadhyay, S. R. (Banaras Hindu Univ., Varanasi, India). Indian J. Chem., 3: 285-6(July 1965).

Crystalline cesium nitrate underwent a phase transformation at 161°C. Below this transition temperature, gamma-irradiated cesium nitrate exhibited the usual smooth isothermal annealing kinetics whereas above this temperature the process was discontinuous. The pattern and the magnitude of the annealing were the same for different temperatures above the transition temperature, and only a fraction of the damage was annealed because of partial loss of the radiolytic oxygen from the crystals during the phase change. (auth)

42542 THE NATURE OF THE REDUCING SPECIES IN THE RADIOLYSIS OF ACIDIC AQUEOUS SOLUTIONS AT HIGH INTENSITIES. Thomas, J. K. (Argonne National Lab., Ill.). Intern. J. Appl. Radiation Isotopes, 16: 451-6(Aug. 1965).

Radiolysis of acidic aqueous solutions with single 1.4-μsec pulses of 13-Mev electrons from a linear accelerator was studied, over the intensity range $1.56 \times 10^{19} \rightarrow 1.23 \times 10^{22}$ ev l^{-1}/pulse. The effect of hydrogen peroxide, oxygen, and cupric ions on $G(H_2)$ was noted. Up to an intensity of 6.24×10^{19} ev l^{-1}/pulse, the scavenging action of the solutes on the $G(H_2)$ could be explained in terms of H atoms and the rate constants associated with H atoms eg $2k_{H+H} = 2 \times 10^{10} \underline{M}^{-1}$ sec^{-1} etc. At higher intensities the scavengers became more effective in decreasing the $G(H_2)$. At these high intensities more hydrogen peroxide was needed to produce the same percentage lowering of $G(H_2)$ when trains of pulses were used instead of the normal single pulse. This was interpreted in terms of a species being produced in one pulse that lived for long enough to contribute to a following pulse. It was postulated that at intensities greater than 6.24×10^{19} ev l^{-1}/pulse (1.4-μsec pulse) the predominant reducing species is H_2^+ with $k_{H_2^+ + H_2^+} < 5 \times 10^5 \underline{M}^{-1}$ sec^{-1}. The scavenging effect of hydrogen peroxide on the molecular hydrogen yield in ^{60}Co γ radiolysis is discussed. (auth)

42543 ELECTRON SPIN RESONANCE OF γ-IRRADIATED SODIUM CITRATE PENTAHYDRATE AND PENTADEUTERATE. Russell, David B. (Argonne National Lab., Ill.). J. Chem. Phys., 43: 1996-2000(Sept. 15, 1965).

An analysis of the electron spin resonance spectra of γ irradiated single crystals of sodium citrate pentahydrate and sodium citrate pentadeuterate, deuterated by exchange with deuterium oxide, indicates that two long-lived radicals are present in both the protonated and deuterated. One radical gives principal values of the proton hyperfine tensor of −91.1, −54.2, and −36.7 Mc/sec. The second radical gives a triplet with relative intensities 1:2:1 and splittings of 16 and 15 Mc/sec along the [100] and [001] axes of the crystal, respectively, and a quartet of lines of equal intensity with splitting of 21.5 and 28.0 Mc/sec along the [010] axis of the crystal, due to the interaction of two protons with the unpaired electron. (auth)

42544 UNPAIRED ELECTRON STATISTICS IN IRRADIATED LiF. Van Den Bosch, A.; Schotsmans, L. (SCK-CEN, Mol, Belg.). J. Phys. Chem. Solids, 26: 1215-24(Aug. 1965).

On the basis of a simplified model, average concentrations of unpaired electrons in neutron-irradiated single crystals of lithium fluoride were calculated by the Monte Carlo method. A one-dimensional model was studied in which the Monte Carlo calculations were checked by solving the corresponding differential equations. The final three-dimensional version resulted in a curve, representing the calculated concentration of unpaired electrons versus the defect concentration. The curve was similar in shape to the one obtained from magnetic susceptibility data versus neutron dose. The absolute value of the maximum concentration was about the same for both curves. Two assumptions in particular led to this result: the electrons of adjacent defects were thought to form 'non inert' pairs, and the newly formed defects were allowed to migrate over a few lattice distances toward existing centers. (auth)

42545 ELECTRICAL CONDUCTIVITY INDUCED IN MgO BY RELATIVISTIC ELECTRON BOMBARDMENT. Pollard, John H.; Bowler, David L.; Pomerantz, Martin A. (Franklin Inst., Swarthmore, Penna.). J. Phys. Chem. Solids, 26: 1325-41(Aug. 1965).

Observations were made by three different techniques, of the conductivity induced in single crystals of MgO when they were irradiated by relativistic electrons that traversed the targets with small energy loss. Investigation of the relationship of the crystal current, immediately following cessation of the bombardment, to the total dosage showed that the initial post-bombardment conductivity builds up to a temperature-dependent saturation value. A model that ascribes the post-bombardment conductivity to charge carriers thermally emitted from a single trapping level, which predominates in a given temperature range, was formulated. Measurements of the decay of post-bombardment conductivity in the range from 70 to 130°C were in accord with theoretical predictions based on an analysis of the kinetics of this process, taking into account both retrapping and monomolecular recombination processes. It was determined that the activation energy for the centers is 0.96 ev, and that the attempt to escape frequency is 10^{10} sec^{-1}. The initial trap occupation for a constant bombardment was found to be not strongly dependent on temperature over the range considered. It was also established that neither radioinduced defects nor iron, a major impurity in MgO crystals, constitute the trapping centers and that their concentration could be increased by annealing the crystal. The post-bombardment thermally stimulated conductivity was studied by a method similar to that utilized heretofore in photoconductivity experiments, and traps were detected at 0.96, 1.20, 1.32, and 1.69 ev. The density of the first was of the order 10^{17} cm^3, but the trap concentrations were observed to vary appreciably among different specimens. Theoretical considerations predicting a dependence of yield (crystal current/primary current) on trap occupation, as a function of temperature and bombardment, were confirmed by bombardment-induced conductivity measurements. The true mobility variation with temperature was determined under conditions of constant trap occupation (empty traps). The data, extending to 600°K, agreed with theoretical calculations in which the mean scattering time is $(1/\tau_0 + 1/\tau_a + 1/\tau_i)^{-1}$ where τ_0 is the relaxation time of the scattering of the carrier for the optical modes, τ_a for the acoustical modes and τ_i for ionized imperfections. The temperature variations of mobility determined by post-bombardment and bombardment-induced conductivity measurements over the range from 80 to 120°C were consistent. The mobility of charge carriers in MgO was about 10 cm^2/volt sec. (auth)

42546 INVESTIGATIONS IN THE FIELD OF RADIATION-INDUCED SOLID-STATE POLYMERIZATION. VII. INFLUENCE OF THE FORMED POLYMER ON THE KINETICS OF THE SOLID STATE POLYMERIZATION. Hardy, Gyula; Varga, Jozsef. Magy. Kem. Folyoirat, 71: 251-4 (June 1965). (In Hungarian).

The influence of the formed polymer was investigated in monomer-polymer systems during radioinduced solid-state polymerization. It was found that the formed polymer had a great accelerating effect on the polymerization of N-vinyl-succinimide. This may be explained by deformations in the crystal lattice (partly decomposed crystal structure) and by greater mobilities of monomer molecules caused by the polymer formed. This influence was expected to be general for monomers of an accelerating kinetic character in solid-state polymerization. On the contrary, the influence of the formed polymer was reversed, i.e. retarding, in the solid-state polymerization of monomers that followed slowing-down polymerization kinetics. (auth)

42547 INVESTIGATIONS IN THE FIELD OF RADIATION-INDUCED SOLID-STATE POLYMERIZATION. VIII. THE γ-RAY INDUCED RADIATION POLYMERIZATION OF VINYL CHLOROACETATE IN THE LIQUID, SOLID AND UNDERCOOLED LIQUID STATES. Hardy, Gyula; Boros-Gyevi, Janosne. Magy. Kem. Folyoirat, 71: 234-8(June 1965). (In Hungarian).

The kinetic behavior of gamma-induced polymerization of vinyl chloroacetate was investigated in the liquid, solid, and supercooled liquid states. The kinetics of the polymerization in all the three states were of an accelerating character, and in the liquid and supercooled liquid states the process was inhibited by the inhibitors of radical-type polymerizations. Only a small retarding effect was observed in the solid state. In comparison with vinyl acetate, vinyl chloroacetate had a greater tendency for polymerization in the solid state. (auth)

42548 DESIGN AND ECONOMIC STUDY OF A GAS-PHASE CHEMONUCLEAR OZONE PROCESS. Beller, M.; Goellner, D.; Steinberg, M. (Brookhaven National Lab., Upton, N. Y.). Nucl. Appl., 1: 322-6(Aug. 1965). (BNL 8753).

An evaluation of the economics of producing ozone from oxygen in a system utilizing fission fragment energy is

presented along with a study of the design of such a system. The study covers a range of G values for ozone formation from 3 to 15 and chemonuclear reactor ozone concentrations from 10 parts/10^6 to 10% at an operating temperature of −20°C. A graphite-moderated nuclear reactor design, which utilizes a 2.5-μm thick U–Pd alloy foil as fuel elements, is employed. Ozone is separated by adsorption on silica gel; decontamination procedures are described. Investment and operating costs for the chemonuclear and conventional methods of ozone production were compared for an ozone production rate of 100 ton/d. It was concluded that the chemonuclear route becomes competitive with conventional ozonizers at a steady-state concentration of 0.1% ozone for a G value of 9 and at a concentration as low as 150 parts/10^6 for a G value of 15. The study indicated the need for research on fission fragment and radiation chemistry in the ozone-oxygen system at temperatures from 20 to −78°C for determining the feasibility of these yields. (auth)

42549 FISSION-PRODUCT EFFECTS IN MOLTEN CHLORIDE FAST-REACTOR FUELS. Chasanov, M. G. (Argonne National Lab., Ill.). Nucl. Sci. Eng., 23: 189-90 (Oct. 1965).

The chemical effects of large quantities of fission products on fuel performance and stability are estimated for fast-neutron irradiation of $PuCl_3$ in a molten chloride fuel. A plot of the average fission-product valency of this reaction as a function of irradiation time, assuming retention of all rare gases in the system, is given and discussed. Interaction of fission products with the environment is also considered. It is noted that massive precipitation of noble metals or insoluable salts in mobile fuel would lead to serious operational difficulty, such as local hot spots or plugged piping. Early removal of such fission products is suggested. (J.F.P.)

42550 INTRINSIC F-COLORATION LEVEL IN NaCl IRRADIATED WITH X AND γ RAYS AT ROOM TEMPERATURE. Agullo-Lopez, F.; Alvarez-Fivas, J. L. (Junta de Energia Nuclear, Madrid). Phys. Letters, 18: 254-5 (Sept. 1, 1965).

A few remarkable results from analysis of the initial stage in NaCl are presented. A number of x-ray effective energies as well as ^{60}Co rays were used. For some energies the effect of radiation intensity was also considered. Samples were cleaved from a large NaCl single crystal. The analysis of the first stage of the F coloration curves shows the data for the x-ray irradiations at different effective energies and intensities. The data for γ irradiations and intensities between 1.666 and 33.333 R/min are analogous. In all cases two different regions are clearly apparent. For one of them the F center concentration rises rapidly. For the other the growth is slower and exponential. The fast-growing region depends on the intensity and possibly on the effective energy of the radiation, and is observed to vary from sample to sample. The exponential region saturates at a level which is independent of specimen, radiation intensity, and effective energy of the radiation. It corresponds to about 2×10^{16} F centers/cm^3 and seems an intrinsic parameter of the crystals. Therefore the total saturation level of F coloration depends on radiation intensity but this dependence occurs only through the fast growing region. (J.F.P.)

42551 THE EFFECT OF GAMMA-IRRADIATION ON PEPTIDES. I. THE EFFECT OF GAMMA-IRRADIATION ON AQUEOUS SOLUTIONS OF TRIGLYCINE. Leone, Charles A.; Kang, Man-Sik (Univ. of Kansas, Manhattan). Radioisotopes (Tokyo), 14: 303-8(July 1965).

The effect of gamma-irradiation on aqueous solutions of triglycine was studied by means of spectrophotometry of the biuret complex, ultraviolet absorption technique, paper chromatography, low voltage electrophoresis of the copper complex, and carbonyl compound determination. Initial G values for peptide bond rupture at various concentrations and carbonyl compound formation were determined. (auth)

42552 DISTRIBUTION OF VALENCE STATES OF RECOIL ANTIMONY ATOMS IN INORGANIC COMPOUNDS. Kambara, Tomihisa (Shizuoka Univ., Japan); Kashihira, Nobuyuki; Hagita, Katsuyuki; Ke, Chung-huei. Radioisotopes (Tokyo), 14: 353-6(Sept. 1965).

Potassium antimonate was irradiated with thermal neutrons to investigate the distribution of recoil antimony atoms between the tri- and pentavalent states. The retention values were found to be decreased linearly with the decrease of the amounts of crystalline water in the compound. It may be supposed that the OH radical in the crystal may play an important role on the valence states of recoil antimony atoms. This supposition might be reasonable as compared with the results obtained for the antimony exchange reaction in a heterogeneous system (liquid-solid system). (auth)

42553 ELECTRON SPIN RESONANCE SPECTRA OF γ-IRRADIATED SULPHONES AND POLYSULPHONES. Ayscough, P. B.; Ivin, K. J.; O'Donnell, J. H. (Univ. of Leeds, Eng.). Trans. Faraday Soc., 61: 1110-17(June 1965).

The mechanism of radiolysis of sulfones and polysulfones has been investigated, primarily by means of ESR spectroscopy. The radicals trapped in the γ-irradiated sulfones and polysulfones appear to be mainly alkyl radicals formed by cleavage of the C—S bonds. Small amounts of RSO_2 radicals are sometimes present at −196°, as well as radicals formed by loss of an α-hydrogen from the parent molecule. On warming the irradiated samples, the simple alkyl radicals disappear first. At room temperature only the RSO_2 radicals, characterized by an asymmetric singlet, have appreciable stability. In some cases the number of RSO_2 radicals increases as the sample is warmed. The disappearance of the other radicals occurs more quickly for polysulfones than for sulfones. A mechanism in which the weakest bonds (C—S) are preferentially broken is suggested by the results. C—H fission appears to play a relatively minor role. (auth)

42554 ENERGY TRANSFER IN THE RADIATION CHEMISTRY OF BENZENE SOLUTIONS OF DIMETHYL FUMARATE. Nosworthy, Judith (Guy's Hospital, London). Trans. Faraday Soc., 61: 1138-45(June 1965).

Irradiation of benzene solutions of dimethyl fumarate with γ-radiation causes cis-trans isomerization to dimethyl maleate and also destruction of the ester. During pulse radiolysis of benzene solutions containing anthracene and fumarate, triplet anthracene molecules are produced in lower yield than in solutions containing anthracene only. Comparison of the pulsed and continuous irradiation experiments indicates that transfer of electronic excitation energy from benzene in a triplet state could account for all the isomerization. (auth)

42555 RADIOLYSIS OF LIQUID CARBON DIOXIDE WITH GAMMA RAYS. Baulch, D. L.; Dainton, F. S.; Willix, R. L. S. (University of Leeds, Eng.). Trans. Faraday Soc., 61: 1146-55(June 1965).

The γ-radiolysis of liquid carbon dioxide at −48°C was studied over the dose-rate range $3.7 \times 10^{18} - 5.8 \times 10^{19}$ ev/l/sec. The only products are CO, O_2 and O_3. G(CO) falls from 5.0 to 3.5 ± 0.2 and $G(O)_2$ rises from 0.2 to 0.6 ± 0.2 as the dose is increased; $G(O_3) < 0.7$. None of these values is dependent on dose-rate. These results, the effects of various additives, and the radiation stability of gaseous CO_2 are discussed. It is concluded that ionic reactions are absent in the liquid where the primary species are excited CO_2^*, CO and O, the last forming O_2 and O_3 in well-established reactions; whereas in the gas phase there is a rapid ionic back reaction, e.g., $O_2^- + CO \rightarrow CO_2 + O^-$; $O^- + O_3 \rightarrow O_2 + O_2^-$. (auth)

42556 PHOTOLYSIS AND RADIOLYSIS OF CONCENTRATED AQUEOUS SOLUTIONS OF HYDROGEN PEROXIDE. Currie, D. J.; Dainton, F. S. (Univ. of Leeds, Eng.). Trans. Faraday Soc., 61: 1156-65(June 1965).

The γ-ray induced, and photochemical, chain decompositions of stirred, concentrated aqueous solutions of hydrogen peroxide at 10 and 25°C and at natural pH and pH 1 have been investigated gasometrically. The curves of decomposition rate against peroxide concentration always have a maximum. The dose-rate and light intensity exponents in the empirical rate equation are close to 0.5 and the kinetic

chain life-time (measured by the rotating sector method) is independent of the peroxide concentration but shorter at natural pH than at pH 1. The results are explicable on the basis that (i) at pH 1 the chain carriers are OH and HO_2 whereas at natural pH they are OH and O_2^-; (ii) $k(2HO_2 \rightarrow H_2O_2 + O_2) = 2 \times 10^6$ $\underline{M}^{-1}$ sec^{-1}; (iii) the form of H_2O_2 which reacts with HO_2 or O_2^- in the propagation step is the dihydrate, and (iv) $K_{HO_2} \simeq 1.5$ $[H^+]$ in concentrated peroxide solutions at 10°C. (auth)

42557 GAMMA-RADIOLYSIS OF CYCLOPENTANONE. PART I. PRODUCTS FROM C—H BOND CLEAVAGE. Dugle, David L.; Freeman, Gordon R. (Univ. of Alberta, Edmonton, Can.). Trans. Faraday Soc., 61: 1166-73(June 1965).

The major products of C—H bond cleavage reactions in the gamma radiolysis of liquid cyclopentanone, together with their initial G values, are: hydrogen, 0.78; cyclopentanol, 0.8; cyclopentanone, 0.10; "dimer," 1.1; polymer, 1.9 cyclopentanone units. The polymer was not completely characterized, so it might have contained some open chain units. Its average molecular weight was between that of a tetramer and a pentamer of cyclopentanone. Benzene appears to inhibit the formation of these products by an activation transfer mechanism. A reaction between "free ions" is not involved in the production of hydrogen: $A^+ + B^- \not\rightarrow H_2 + P$. 1,3-Pentadiene inhibition of hydrogen formation appears to involve more than one process. The diene inhibits the formation of the other products by a free-radical scavenging mechanism. The radiolysis of cyclopentanone is very similar to that of cyclohexanone. (auth)

42558 GAMMA-RADIOLYSIS OF CYCLOPENTANONE. PART 2. PRODUCTS FROM C—C BOND CLEAVAGE. Dugle, David L.; Freeman, Gordon R. (Univ. of Alberta, Edmonton, Can.). Trans. Faraday Soc., 61: 1174-81(June 1965).

The major products of C—C bond cleavage reactions in the gamma radiolysis of liquid cyclopentanone, together with their initial G values are: carbon monoxide 0.67 ± 0.06; ethylene 0.80 ± 0.04; 4-pentenal 0.83 ± 0.10. Traces of C_2 and C_4 hydrocarbons were also produced. Benzene sensitizes the formation of 4-pentenal whereas oxygen and 1,3-pentadiene inhibit it. It appears that these sensitization and inhibition reactions involve the lowest triplet state of cyclopentanone. It is suggested that the lowest triplet state of cyclopentanone is the precursor of about 70% of the 4-pentenal formed; the precursor of the other 30% is not readily affected by pentadiene or oxygen. The yields of carbon monoxide and ethylene are slightly sensitized by benzene and slightly inhibited by 1,3-pentadiene. The reaction mechanism is discussed. (auth)

42559 KINETICS OF THE DECOMPOSITION OF NICKEL OXALATE. Dominey, D. A. (Atomic Energy Research Establishment, Harwell, Eng.); Morley, H.; Young, D. A. Trans. Faraday Soc., 61: 1246-55(June 1965).

The isothermal decomposition in vacuo of nickel oxalate between 230 and 260°C commences with a grain boundary reaction of contracting area form having an activation energy of 38 Kcal/mole. After an induction period with an activation energy of 51.6 Kcal/mole during which metallic nickel diffuses to potential nucleus forming sites, the main acceleratory reaction commences. This reaction, which has an apparent activation energy of 36 Kcal/mole, is initially cubic but later becomes parabolic, particularly at the lower temperatures, behavior which is ascribed to a temperature-dependent distribution of originally spherical nuclei along linear imperfections. In neutron-irradiated material, all stages of the reaction are enhanced in extent of rate, and the activation energy of the induction period is reduced to ~38 Kcal/mole. These effects are discussed in terms of the reactant topography. (auth)

42560 THE OXIDATION OF TETRAVALENT URANIUM IONS IN PERCHLORIC ACID SOLUTION UNDER ^{60}Co γ IRRADIATION. Sobkovski, E.; Zalkind, Ts. I. (Karpov Inst. of Physics and Chemistry, USSR). Zh. Fiz. Khim., 39: 1388-92(June 1965). (In Russian).

The oxidation yield of tetravalent uranium ions in perchloric acid solution under γ irradiation and the dependence of the yield on the concentration of U(IV) and perchlorate ions were determined. The disproportionation constant of the pentavalent U ions in 0.04 N perchloric acid was determined. It was found that the presence of ClO_4^- ions in the solution leads to increased oxidation yields of U(IV). It was established that the speed of the radiochemical oxidation of pentavalent U ions is approximately 100 to 150 times greater than the velocity of the oxidation of U(IV) ions. (tr-auth)

42561 RADIATION CHEMISTRY OF CARBOHYDRATES. IV. RADIOLYSIS OF LACTOSE AND CELLOBIOSE AQUEOUS SOLUTIONS. Kochemkov, N. K.; Kudryashov, L. I.; Yarovaya, S. M.; Boriova, E. I. (Inst. of Natural Compounds, Academy of Sciences, USSR). Zh. Obshch. Khim., 35: 1191-4(July 1965). (In Russian).

Radiolysis of 0.01M lactose and cellobiose aqueous solutions was carried out in a nitrogen atmosphere. The reaction was subordinate to the first-order equation. Hydrolysis was the basic process in lactose and cellobiose radiolysis. The rate of lactose hydrolysis was 1.5 times faster than that for cellobiose. The acid products were observed following the radiolysis and ~50% of the acids appeared as a result of secondary irradiation processes. (R.V.J.)

42562 ELECTRON PARAMAGNETIC RESONANCE IN IRRADIATED TOPAZ. Samoilovich, M. I.; Novozhilov, A. I. (All-Union Research Inst. of Synthesis of Mineral Resources in Alexandrov, USSR). Zh. Strukt. Khim., 6: 461-3(May-June 1965). (In Russian).

Several varieties of Volyn topaz were studied by means of electron spin resonance spectra at 77 and 295°K. In all natural brown topaz varieties as well as in samples irradiated with x or gamma rays, the ESR spectrum showed a broad isotropic line with $g = 1.982 \pm 0.002$ and a half-width $\Delta H \approx 50$ Oe with a complex hyperfine structure (HFS). The intensity and number of the HFS lines depended on the orientation of the crystal in the magnetic field. This spectrum was related to the brown color produced by irradiating colorless samples. The spectral line intensity and optical density at first increased symbatically in proportion to the dose, then became saturated at total doses of about 10^6 R. Both the color and ESR spectrum disappeared when the samples were heated to 300°C. The observed ESR spectrum is described mathematically in terms of the mechanism of W. C. Holton and H. Blum (Phys. Rev., 125: 89 (1962)). (CFSTI)

42563 THE GAS PHASE RADIOLYSIS OF NEOPENTANE (thesis). Lias, Sharon Garrison. Washington, D. C., American Univ., 1964. 48p.

The radiolysis of neopentane was investigated in the gas phase. It was demonstrated that the ethyl, vinyl, allyl, and propyl ions formed in the decomposition of the parent ion undergo hydride transfer reactions with the neopentane molecule, thus forming the corresponding neutral molecules. The tertiary butyl ion, on the other hand does not undergo a hydride transfer reaction with the parent molecule. Variations in product yields with change in pressure and in the presence of added inert gas were examined. Although the data indicated that neutral excited molecule decompositions contribute to the observed product yields, it was impossible to estimate the extent of this contribution from the data obtained. (Masters Abstr. 2: No. 2, June 1964)

42564 (STI/PUB/91(Vol. II)) CHEMICAL EFFECTS OF NUCLEAR TRANSFORMATIONS. VOL. II. Proceedings Series. Proceedings of the Symposium Held in Vienna, 7—11 December 1964. (International Atomic Energy Agency, Vienna). Apr. 1965. 567p. (CONF-773(Vol.II)). IAEA $11.00; S 231,-; £3.6.0; F.Fr. 44,-; DM 38,50 cy.

Thirty-five articles and one single abstract are included; separate abstracts were prepared for 12. Twenty-two articles were previously abstracted in NSA as 19: 9166, 9168; 11172; 13486; 13487; 13489; 13492; 13493; 13497; 13499; 13500; 13502; 13504; 13505; 13506; 13517; 13518; 13519; 15644; 15647; 18037; and 26381. The single abstract on

chemical effects following thermal neutron capture in potassium chromate was not included in NSA. (P.C.H.)

For abstracts of individual papers see: 42565–42576.

42565 CHEMICAL STATE OF RADIOBROMINE FORMED BY THE $^{85}Rb(n,\alpha)^{82}Br$ REACTION. Vlatkovic, M.; Kaucic, S. (Ruder Boskovic Inst., Zagreb). pp 3-12 of STI/PUB/91(Vol.II).

A study was made of the chemical distribution of radiobromine between its higher (BrO_3^-) and lower (Br^-, Br_2, BrO^-) oxidation states produced by nuclear reaction $^{85}Rb(n,\alpha)^{82}Br$ in a number of rubidium inorganic solids. The samples of dried Rb_2SO_4, $Rb_2S_2O_8$, $RbMnO_4$, $RbNO_3$, Rb_2CO_3, and $RbIO_3$ were irradiated with 14 Mev neutrons by a (T + d) neutron generator. It appeared that in the case of Rb_2SO_4 irradiated at room temperature or at −195°C approximately 8% of total ^{82}Br activity was found in the bromate fraction, the rest following the bromide fraction. The room temperature irradiation of $RbMnO_4$ and $RbNO_3$ yielded about 1% of activity in the higher oxidation state of bromine and in the cases of $Rb_2S_2O_8$, Rb_2CO_3 and $RbIO_3$ activity could be measured only in the bromide fraction. A small increase of the bromate activity was observed when neutron-irradiated Rb_2SO_4 was heated up to 250°C. At higher temperatures (up to 500°C) the activity passed into the lower oxidation state. Heating the irradiated $RbMnO_4$ and $RbNO_3$ did not provoke any oxidation of bromine activity. While in the case of $RbNO_3$ pre-irradiation γ dose of 22 MRad had no influence upon the distribution of bromine recoils, the analysis of Rb_2SO_4 pretreated with γ rays (55 MRad) gave higher bromate activity compared with the samples that before neutron irradiation had only been dried at 150°C. In conclusion the significance of the chemical constitution of the target compound and non-isotopic media with regard to the distribution of highly energetic ^{82}Br atoms and to their inability to anneal in the rubidium compounds investigated is stressed. (auth)

42566 CHEMICAL TRANSFORMATIONS ASSOCIATED WITH THE REACTION (n,γ) ON Te^{VI} AND WITH THE ISOMERIC TRANSITIONS OF HEXAVALENT RADIOTELLURIUM. Bertet, M.; Muxart, R. (Institut du Radium, Arcueil, France). pp 13-29 of STI/PUB/91(Vol.II). (In French).

The chemical transformations accompanying neutron irradiation of telluric acid were studied under varying experimental conditions. In particular, a study was made of the consequences of the (n,γ) reaction on Te(VI), as well as those of the isomeric transitions $^{131m}Te \xrightarrow{(VI)\gamma} {}^{131}Te$ and $^{129m}Te \xrightarrow{(VI)\gamma} {}^{129}Te$. The existence of a Szilard-Chalmers effect was demonstrated. As radiotellurium appears mainly in the hexa- and tetravalent states, the retention of Te*(VI) was determined by separating Te*(IV) and Te*(VI) by chromatography, paper electrophoresis, or extraction with solvents. The retention of Te*(VI) in telluric acid irradiated to a crystallized state has substantially the same value for the basic isomers ^{131}Te, ^{129}Te and the system $^{131}Te + {}^{129}Te + {}^{127}Te$. It depends upon the type of reactor chosen, its mean value varying from about 39 to 55%. It increases slightly with the duration of irradiation and rises if the acid is irradiated in an aqueous solution. The total retention R of the metastable isomers (^{129m}Te, ^{127m}Te, ^{125m}Te, ^{123m}Te, $^{131m}Te + {}^{121}Te$) is particularly important because it can reach more than 98%. It seems to be independent of the solvent in the case of crystallized telluric acid, but grows with the pH if irradiation takes place in solution. R increases still further with the concentration of Te(VI) and the duration of irradiation; it decreases with the degree of hydration of the acid. The internal conversion of gamma radiation in isomeric transitions brings about a reduction in the fundamental isomer (^{131}Te or ^{129}Te) when its precursor is in a hexavalent state. The corresponding retention depends upon the pH and increases with it. In particular, it increases from 40% to 80% for the isotope ^{129}Te going from 3M HCl to 6M NaOH. The retention of $^{131}Te(VI)$ seemed lower than that of ^{129}Te-(VI) but the existence of an isotope effect remains uncertain. In the course of the nuclear transformations studied, the reduction of Te*(VI) to Te*(IV) seems to take place through a similar state of radiotellurium, the exact nature of which has yet to be determined. (auth)

42567 SOME REACTIONS OF RECOIL ATOMS IN SOLID INORGANIC PHOSPHORUS COMPOUNDS. Lindner, L.; Zwenk, H.; Van Den Ende, H.; Drost-Wildschut, H.; Lasthuizen, M. (Instituut voor Kernphysisch Onderzoek, Amsterdam). pp 109-24 of STI/PUB/91(Vol.II).

The possibility for tritium recoils to replace (displace) either an oxygen or a hydrogen atom bound to phosphorus was evaluated. For instance, oxygen replacement in an orthophosphate ion $(PO_4)^{3-}$ could lead to a $(TPO_3)^{2-}$ ion (phosphite), hydrogen replacement in hypophosphite could lead to $(HTPO_2)^-$. A number of lithium salts of orthophosphoric, phosphorous, and hypophosphorous acid were irradiated with neutrons, the nuclear reaction $^6Li(n,\alpha)^3H$ serving as the source for the energetic tritium atoms. Through a step-wise oxidation procedure tritium bound to phosphorus was converted into HTO and radioassayed by means of liquid scintillation counting. The results indicate that replacement of oxygen by tritium in orthophosphates is highly unlikely. When prosphites and hypophosphites are the target material, an appreciable percentage of the tritium recoils end up bound to phosphorus. Also, an investigation was made to determine to what extent the labeling of the tripolyphosphate−^{32}P anion, formed by recoiling ^{32}P particles in a number of crystalline phosphates, deviates from a uniform distribution. A number of phosphates were irradiated with neutrons. The tripolyphosphate−^{32}P formed was separated by precipitation as the tris(ethylenediamine) cobalt(III) salt. By means of a step-wise degradation into orthophosphate the distribution of the ^{32}P among the two possible positions in the anion was measured. One result was that when anhydrous orthophosphates are the target material, there is as predicted, a strong preference for the tripolyphosphate−^{32}P formed to be labeled at the center. These and other results are discussed in the light of current concepts of hot-spot reactions. (auth)

42568 COMPARATIVE STUDIES OF CHEMICAL EFFECTS FOLLOWING NUCLEAR REACTIONS AND TRANSFORMATIONS ON METAL ORGANIC PHENYL COMPOUNDS. Merz, E.; Riedel, H. J. (Kernforschungsanlage, Juelich, Ger.). pp 179-94 of STI/PUB/91(Vol.II).

A study of the chemical effects created by the energetic recoil atoms of nuclear reactions in solids and liquids was made on the basis of a broad comparison of the products formed by (n,γ) and $(n,2n)$ processes in the metalphenyl compounds of germanium, tin, lead, arsenic, and antimony. In addition, the radioactive recoil products formed after the K-capture process on ^{68}Ge-tetraphenyl were compared with the results from the (n,γ)-process on Ga-triphenyl and the (n,p) process on Ge-tetraphenyl. Finally, the studies include the β^- transition on Ge^{IV}-tetraphenyl to As^V. Applying different separation methods, e.g., adsorption chromatography on alumina, ion exchange, and electrophoresis, the various radioactive recoil products were separated and the individual yields determined. It was found that in nuclear reactions the compounds of the mentioned metals having identical ligands formed practically the same classes of recoil products. The yield distribution however revealed characteristic alterations between the (n,γ) and $(n,2n)$ reaction. Only a small influence on the yields was perceptible when irradiations were performed in liquids and solutions. The large differences found for the new compounds formed by nuclear transformations were striking, not only in the kind of typical products but also in their percentage yields. Thus, several recoil products of Ge and Ga with metalorganic character were found by nuclear reactions on Ge-tetraphenyl that could not be detected at all by the K-capture process on ^{68}Ge-tetraphenyl. The β^- decay on ^{77}Ge-tetraphenyl produces practically the same chemical compounds as were observed by nuclear reactions. However, a remarkable increase in the portion of the labeled parent molecules (retention) was typical for the β^- transition. The results are discussed on the basis of theoretical considerations of the amount of kinetic energy transferred to the reacting molecule by the nuclear recoil and the resulting excitation. The hypothesis is put forward that the kind and quantity of certain new radioactive species produced in connection with nuclear events is less a function of the nature and concentration of pri-

mary recoil fragments than are the ions, radicals, and lattice defects imparted to the irradiated materials by secondary recoil effects (elastic and inelastic interactions), including the peculiar influence of oxygen. (auth)

42569 THE THERMAL AND RADIATION ANNEALING REACTIONS OF RECOIL DAMAGE IN SOLID COBALT(III) AND CHROMIUM(III) TRIS-ACETYLACETONATES. Machado, J. C.; Machado, R. M.; Vargas, J. I. (Universidade de Minas Gerais, Belo Horizonte, Brazil). pp 195-234 of STI/PUB/91(Vol.II).

Results of an investigation on the influence of defects and of solid state dilution on the radiation, photo, and thermal annealing reactions of (n,γ) recoil fragments, formed by pile irradiation of solid Co(III) and Cr(III) tris-acetylacetonates are reported. Irradiation of the solids investigated with different doses of ^{60}Co γ rays (0-50 MRad), as well as their thermal decomposition and/or quenching (50-150°C) after different heating times (20 min−10 hr) prior to the neutron irradiation, led to a lowering of the initial retentions (down to 50% of their normal values) and to a slowing-down of the rates of isothermal annealing. Similar effects were found for crystals irradiated with different pile doses (from 15 to 300 kwh) at room temperature. A detailed investigation of this thermal decomposition as well as the radiolysis of the cobalt complex prompted a reinterpretation of the recoil chemistry of this compound. Evidence is presented for the existence of only two recoil species of chromium and cobalt: the target molecules and the corresponding ionic species (probably $^{51}Cr^{3+}$ and $^{60}CoO^{3+}$; the third reactant (responsible for the observed occurrence of two first order reactions) being an electron. This is thought to be plausible since the first fast process ($T_{\frac{1}{2}} \simeq 20$ min) can be suppressed by the thermal introduction of defects, with approximately the same half life. Analysis of the isothermal and multi-stage annealing reactions of the ^{51}Cr recoils showed that the process is distributed in activation energy, with a maximum at 1.31 ev. Positive results, observed using ^{60}Co γ rays, uv light (mercury arc), and sodium light on the annealing of ^{51}Cr and ^{60}Co recoils generated in crystals of Co(III) and Cr(III) tris-acetylacetonates, are reported. The dose-rate of the cobalt source used (Gammacell 220) was chosen to be the same as that of the reactor position used for the irradiation of the compounds investigated, and this made it possible to show that the retentions observed (9.4% for ^{60}Co and 10.4% for ^{51}Cr for a 100 kwh reactor dose) result only from radiation annealing in pile, and hence the exclusion of a nuclear or a thermal contribution to the retentions. A kinetic investigation of the reactions induced by the different types of exciting radiations used appears to show that the radiation annealing phenomena associated with the chromium and cobalt tris-acetylacetonates crystals can be formally described as zero order processes, inhibited by defects generated by radiolysis or photolysis of these compounds. (P.C.H.)

42570 THE ANNEALING OF (n,γ) RECOIL DAMAGE IN FERROELECTRIC TRI-GLYCINE SULPHATE. Arezzo, Bartyra; Vargas, J. I. (Comissao Nacional de Energia Nuclear, Rio de Janeiro; Universidade de Minas Gerais, Belo Horizonte, Brazil). pp 247-74 of STI/PUB/91(Vol. II).

Experiments conducted with irradiated triglycine sulfate crystal showed wide variations of the ^{35}S retention as a function of the annealing temperature. Annealing both below and above ferroelectric transition temperature (47°C) proceeded at faster rates than at this temperature. The kinetics of annealing as a function of the dielectric constant of the ferroelectric crystals was compared to results obtained for ammonium sulfate (which presents a ferroelectric transition at a much lower temperature). A discussion of the observations is presented in the light of present theories of annealing phenomena. (auth)

42571 THERMAL ANNEALING OF PARAMAGNETIC DEFECTS INDUCED BY GAMMA IRRADIATION IN $(NH_4)_2SO_4$ AND $(ND_4)_2SO_4$ SINGLE CRYSTALS: EXPERIMENTAL VERIFICATION OF THE THEORY OF FLETCHER AND BROWN. Calusaru, A.; Barbur, I.; Ursu, I. (Institut de Physique Atomique, Bucharest; Universite Babes, Cluj). pp 293-313 of STI/PUB/91(Vol.II). (In French).

In irradiated $(NH_4)_2SO_4$ and $(ND_4)_2SO_4$ crystals two paramagnetic species were identified by means of the electron spin resonance method. The g constant of the first radical is 2.014 and of the second 2.020 for the normal hydrogen compound; for the deuterated compound they are 1.996 and 2.0032, respectively. Study of the annealing of the first radical in the 60−170°C range showed that in this case the kinetics display a single plateau corresponding to a total recombination of the radicals. For each isotherm it was possible to obtain the appropriate equation using the errors function derived by Fletcher and Brown and taking as a model the recombination of initially correlated (and subsequently liberated) pairs by a random-walk process. Agreement between this function and experimental results was obtained after correcting the function by a factor α. The composite annealing curve is in good agreement with the corrected errors function. Using the phenomenological method of Fletcher and Brown for calculating the activation energy, a value of 1.594 ev was obtained, corresponding to the first radical in $(NH_4)_2SO_2$. On the basis of the variation of the diffusion coefficient with temperature, a value of 1.592 ev was obtained, for the same activation energy. With the Vand-Primack method 1.45 ev was obtained, which is lower than the two preceding values. It was concluded that the recombination of correlated pairs by a random-walk process can be used as a model in the form given by the theory if the interaction between the species formed and the lattice is fairly weak; in this way the pairs which are initially correlated can be liberated. (auth)

42572 RADIOCHEMICAL PROCESSES IN IRIDIUM COMPLEXES. PART II. PRODUCTS FROM THE (n,γ) PROCESS IN AMMONIUM CHLOROIRIDATE. Peixoto Cabral, J. M. (Junta de Energia Nuclear, Sacavem, Portugal). pp 325-35 of STI/PUB/91(Vol.II).

Experiments on the study of the effects of radiative thermal neutron capture in chloro complexes of iridium have shown that, in contradiction to earlier reports, all the products found in solutions of irradiated sodium chloroiridate crystals are also present in the solutions of ammonium chloroiridate irradiated under the same conditions. Three more species, further observed in the latter solutions, are most probably chloroammine and aquochloroammine complexes of iridium III. It was found too that the hydrolysis of chloroiridate is accelerated in the presence of HN_4^+ ions. (auth)

42573 THE USE OF THE MOESSBAUER EFFECT IN INVESTIGATING THE CHEMICAL EFFECTS OF NUCLEAR TRANSMUTATIONS IN OXYGENOUS COMPOUNDS OF MANGANESE AND TIN. Nesmeyanov, An. N.; Babeshkin, A. M.; Kosev, N. P.; Bekker, A. A.; Lebedev, V. A. (Moscow State Univ.). pp 419-41 of STI/PUB/91(Vol.II). (In Russian).

The forms of stabilization of ^{56}Mn recoil atoms in irradiated solutions and solid samples of permanganate, and of ^{119m}Sn recoil atoms in stannic oxide and stannous oxide were investigated. The permanganate samples were irradiated in a paraffin block with a polonium-beryllium source at a neutron flux of 10^7-10^8 n/cm^2 · s. The hot ^{56}Mn atoms are formed in the 7+, 4+, and lower valency states. From samples (SnO and SnO_2) irradiated in a reactor for 1800 hr at a flux of 2.2×10^{13} n/cm^2 · s, sources were prepared directly for a study of the resonance absorption of gamma-quanta in an apparatus operating at constant speed. Suitable compounds of tin were used as absorbers. The ^{119m}Sn recoil atoms were detected only in the 4+-valency state. The data obtained are taken as the basis for a discussion of the stabilization mechanism of recoil atoms. (P.C.H.)

42574 BOND RUPTURE FOLLOWING ^{14}C AND ^{3}H BETA DECAY. Hsiung, C.; Gordus, A. A. (Univ. of Michigan, Ann Arbor). pp 461-70 of STI/PUB/91(Vol.II). (TID-21771).

Momentum transfer to an atom in a molecule (internal excitation and bond-rupture) have been discussed recently with reference to activation of atoms joined to a molecule by only one bond. Now additional molecules are considered, and data presented on the net recoil energy required for bond-rupture, the rotational and vibrational excitation energies received by the rupturing bond, the internal energy of

the radical originally bonded to the activated atom, and the kinetic energy of the radicals. It is shown that, on the average, the recoil energy that must be acquired by the activated atom in order to rupture from the molecule is about 25% greater than that calculated assuming a pseudo-diatomic molecule. Data are also presented for certain ^{14}C and ^{3}T beta-decay recoil processes. For $^{14}CO_2$ it is calculated that a net ^{14}N recoil energy = 1.92 times the ON-O^+ bond dissociation energy is required for bond-rupture. Since the NO_2^+ product may possess about 0.6 to 1.0 ev of electronic excitation energy, the ON-O^+ bond dissociation energy is not uniquely defined. The calculated value of non-bond-rupture is 73–87% in good agreement with the reported experimental value of 81%. Similar data are also presented for such molecules as CH_3T, C_2H_5T, C_3H_7T, and $^{14}C_2H_6$. (P.C.H.)

42575 CHEMICAL EFFECTS OF NUCLEAR DECAY IN DOUBLY TRITIATED ETHANE AT ATMOSPHERIC PRESSURE. Aliprandi, Bianca, Cacace, F.; Guarino, A. (Universita, Rome). pp 471-82 of STI/PUB/91(Vol.II).

The chemical effects associated with the beta decay of a radioactive atom bound to an organic molecule were investigated by a technique based on the use of doubly labeled compounds. According to this method, doubly tritiated ethane molecules, i.e., ethane-1-2-$^3H_2$, were allowed to decay in the presence of a large excess of inactive ethane at atmospheric pressure. The decay of one tritium atom in a doubly labeled molecule produces a tritiated fragment containing the other ^3H atom. It is therefore possible to identify the products from the nuclear decay of such a molecule by suitable gas chromatographic techniques. Doubly tritiated ethane was obtained from ethylene and pure tritium gas over a chromia catalyst that does not promote the exchange between the hydrogen atoms of the ethylene and the $^3H_2$. The crude ethane 1-2-$^3H_2$ was diluted with inactive C_2H_6 and purified by preparative scale gas chromatography. Its isotopic purity was checked with a mass spectrometric analysis, its radiochemical purity by radio gas chromatography. The doubly tritiated ethane was diluted with inactive ethane to a specific activity about 0.5 mC per mmole, in order to minimize the autoradiolytic decomposition. Samples of ethane-1, 2-$^3H_2$ were stored at atmospheric pressure for a period of time from 15 to 100 days, variable amounts of oxygen having been added to several samples as a radical scavenger. The products identified by a radio gas chromatographic analysis in the stored samples were tritiated hydrogen, methane, and ethylene with smaller amounts of acetylene, propane, and traces of butanes. These products account for about 20% of the activity contained in the labeled fragments from the decay of the doubly tritiated ethane. An attempt was made to correlate the observed products pattern with the reactions of the tritiated ions arising from the decay of $C_2H_4T_2$ in active ethane at atmospheric pressure. (auth)

42576 METHOD OF INVESTIGATING FAST CHEMICAL REACTIONS BASED ON μ^+-MESON DEPOLARIZATION. Firsov, V. G.; Byakov, V. M. (Inst. of Theoretical and Experimental Physics, Moscow). pp 537-45 of STI/PUB/91(Vol.II). (In Russian).

When a μ^+-meson is slowed down in a substance the hydrogenoid muonium atom formed enters into chemical reactions similar to the corresponding interactions of atomic hydrogen. The observed angular distribution effect of the meson decay is associated with the chemical state of the meson. The absolute constants of the rate of the chemical reactions are determined in relation to the known nuclear physical decay characteristics. The method is independent of the state of aggregation of the substance and can be applied at essentially any temperature. Quantitative identification of the classes of the substances obtained (radical and molecular products are determined separately) is possible, as is individual determination based on variations in the precession of the system of spins in the magnetic field using a number of diatomic molecules as an example. The possibility of studying the structural parameters of the radicals and molecules, and of estimating the lifetime of the short-lived intermediate compounds is considered. The elementary steps in fast chemical reactions were investigated. (auth)

Radiochemistry

See also Separation Processes and Procedures.

Refer also to abstract 42255.

42577 (EUR-405.f) MARQUAGE SPECIFIQUE D'HORMONES THYROIDIENNES AU TRITIUM ET ETUDE DE LEUR RADIODECOMPOSITION. (Specific Marking of Thyroid Hormones with Tritium and Study of Their Radioactive Decay). Roche, J. (College de France, Paris. Laboratoire de Biochimie Generale et Comparee). 1963. 7p. Dep. mn.

The method of catalytic hydrogenolysis for the labeling of thyroid hormones with tritium was improved and a new apparatus was constructed. The double bond saturation method by IHT was improved to obtain a better yield of HTo utilization. Six new tritiated thyronines were prepared including $\alpha\beta^3$H-thyronine, 3'-iodothyronine, 3',5'-diiodothyronine, 3-iodothyronine, 3,3'-diiodothyronine, and 3,3',5'-triiodothyronine, and a purification method on Dowex 50 of these compounds was established. From model and biological experiments, theoretical results were obtained representing a basis for a critical analysis of experiments with radiomolecules in biological media. (tr-auth)

42578 (JEN-144-DQ/I-45) PREPARATION OF HIGH SPECIFIC ACTIVITY OF ^{51}Cr BY THE SZILARD-CHALMERS EFFECT ON POTASSIUM CHROMATE. Barrachina Gomez, M.; Villar Castejon, M. A. (Junta de Energia Nuclear, Madrid (Spain)). 1965. 12p. Dep. mn.

A method was developed for preparing ^{51}Cr of at least 10-C/g for medical uses. After irradiation of potassium chromate in the JEN-1 Reactor, the chromate is dissolved in water and the ^{51}Cr is separated as chromium hydroxide. The irradiation time is about three weeks. (D.L.C.)

42579 CHEMICAL EFFECTS ASSOCIATED WITH β-DECAY PROCESS. I. THE CHEMICAL BEHAVIOR OF A DECAYED PRODUCT, ^{144}Pr, IN THE EDTA COMPLEX SYSTEM. Shiokawa, Takanobu; Kudo, Hiroshi; Omori, Takashi (Tohoku Univ., Sendai). Bull. Chem. Soc. Japan, 38: 1340-3(Aug. 1965).

The chemical behavior of ^{144}Pr formed by the β-decay of the ^{144}Ce(III)-EDTA complex was investigated. The chemical behavior of ^{144}Pr was remarkably different from that of ^{144}Ce. The results suggested that an increase in the nuclear charge of ^{144}Pr plays the most important role in determining the yield of ^{144}Pr ions and leads to the extensive disruption of the complex molecule by intramolecular electron transfer. The liberated ^{144}Pr ion forms the complex according to its kinetic law. The recoil as a result of β^- decay seemed not to be the cause of the formation of the free ^{144}Pr ions. (auth)

42580 METHOD FOR THE RADIOCHEMICAL SEPARATION OF PHOSPHORUS. Vidal, Christian (Faculte des Sciences, Bordeaux). Bull. Soc. Chim. France, No. 4, 941-2(Apr. 1965). (In French).

A method for the separation and purification of radiophosphorus in the presence of other radioactive compounds is presented. After addition of carrier in the form of H_3PO_4, the phosphorus is precipitated as ammonium phosphomolybdate in nitric acid medium. The phosphomolybdic acid is then separated by extraction using a mixture of n-butanol-chloroform. The phosphate extracted by passage in an ammonia medium is precipitated by the magnesium mixture. After calcination at 1000°C, phosphorus is obtained as magnesium pyrophosphate. The yield, determined by weight measurements, varies from 75 to 80%. The purity of the sources obtained makes it possible to study the two isotopes ^{32}P and ^{33}P, without interference by other radioisotopes. (tr-auth)

42581 CHERENKOV COUNTING OF AQUEOUS SOLUTIONS. De Volpi, A.; Porges, K. G. A. (Argonne National Lab., Ill.). Intern. J. Appl. Radiation Isotopes, 16: 496-8 (Aug. 1965).

A Cherenkov counting method for aqueous solutions is described and compared with other methods. Large liquid samples, process stream samples, and materials that must be completely recovered are readily Cherenkov counted, provided that activities present emit electrons and positrons of high energies and that the solutions are low in uv-blue absorbance. (F.J.H.)

42582 CHEMICAL SYNTHESIS OF ^{3}H- AND 1-^{14}C-LABELED POLYUNSATURATED FATTY ACIDS. Stoffel, W. (Universitaet, Cologne). J. Am. Oil Chemists' Soc., 42: 583-7(July 1965).

Methods for total synthesis of polyunsaturated fatty acids labeled at the double bonds or the terminal methylene groups with tritium and the carboxyl group with ^{14}C are described. The methods are applicable for all known unsaturated fatty acids with polyallylic structure and all-cis configuration. Details for the synthesis of labeled γ-linolenic acid are given and methods of ozonolysis for determining the structure of unsaturated fatty acids are also described. The following ^{14}C-carboxy-labeled polyunsaturated fatty acids were synthesized: linoleic, γ-linolenic, eicosa-11, 14-dienoic, eicosa-8,11,14-trienoic, and arachidonic (eicosa-5,8,11,14-tetraenoic); linolenic, octadeca-6,9,12,15-tetraenoic, and eicosa-8,11,14,17-tetraenoic; iso-octadeca-6,9,12-trienoic; pentadeca,4,7,10-trienoic; hexadeca-7,10-dienoic and hexadeca-4,7,10-trienoic; octadeca-8,11,14-trienoic acid. The nitrile synthesis with 1-chloro-heptadec-8-ene is useful also for the synthesis of 1-^{14}C-oleic acid. Procedures are also discussed for gas liquid chromatographic analysis, which has proved to be the best method for analysis of the reaction products and intermediates. The reaction sequences discussed are suitable for the synthesis of any polyunsaturated fatty acid desired for biochemical studies. (TCO)

42583 TRITIUM-LABELLED PEPTIDE HORMONES WITH HIGH SPECIFIC RADIOACTIVITY. Collipp, P. J; Kaplan, S. A.; Boyle, D. C.; Shimizu, C. S. N.; Ling, S. M. (Univ. of Southern California, Los Angeles; Children's Hospital of Los Angeles). Nature, 207: 876-7(Aug. 21, 1956).

Tritium-labeled hormones of high specific activity were prepared using the technique of acetylation. The method is briefly described. (P.C.H.)

42584 EXISTING METHODS FOR SPLEEN SCINTIGRAPHY WITH BROMOMERCURI-HYDROXYPROPANE (BMHP-^{197}Hg). Hennig, K.; Franke, W.-G.; Woller, P.; Knoll, P. (Medizinische Akademie Carl Gustav Carus, Dresden; Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Nucl.-Med., 4: 370-82(1965). (In German).

The preparation and use of a new ^{197}Hg-labeled compound, bromomercuri-hydroxypropane, for labeling and altering erythrocytes for spleen scanning is described. The method has certain advantages over spleen scanning with ^{51}Cr-labeled and heat-treated red cells. (auth)

42585 ON RADIOACTIVE LABELED COMPOUNDS. PART II. A REPORT ON THE SYNTHESIS OF ^{131}I-HIPPURAN. Hartrodt, Walter (Institut fuer Kortiko-Viszerale Pathologie und Therapie, Deutsche Akademie der Wissenschaften, Berlin). Nucl.-Med., 4: 423-38 (1965). (In German).

The value of ^{131}I-hippuran for kidney function tests is recognized, and the utility of its synthesis by means of exchange labeling is discussed in detail. The solubility of ortho-iodohippuric acid in water and in diluted acids was determined by the radiometric method. The results of more than 300 exchange tests indicated that the pH-value, the amount of added inactive iodide, and the duration of the exchange period are decisive factors. Sodium ortho-iodohippurate achieves the best exchange efficiency (85 to 90%) at pH 5.7 to 6.0 and 120°C without addition of inactive iodide. A purity control by radiopaperchromatography of ^{131}I-hippuran compounds did not reveal any contamination by ^{131}I-iodide or ^{131}I-labeled ortho-iodobenzoic acid. (auth)

42586 RADIOISOTOPE PRODUCTION. Jezdic, Vojislav. Nukl. Energija, No. 2, 1(Apr. 1965). (In Slovenian).

The very widespread application of radioisotopes in the world and the importance of the results attained, postulate in our country too their accelerated introduction in scientific and technological disciplines. One of the conditions supporting a fast development of radioisotope application is the existence of one's own production. Construction of the first nuclear reactors was planned so that they would be of a type to enable a normal production of radioisotopes. A 6.5 Mw reactor, a cyclotron with a charged particles beam (deuterons up to 16 Mev, protons up to 8 Mev, and alpha particles up to 32 Mev) and a planned 200-kw TRIGA Mark reactor are discussed as sources of radioisotopes. Procedures for the production of radioisotopes and labeled compounds were worked out. The necessary laboratories and equipment were constructed to be used both for the production of radioisotopes and labeled compounds, and for their detection and measurements. At the Boris Kidrič Nuclear Institute isotope production started in 1961, and that of labeled compounds in 1964. The Ruder Bošković Nuclear Institute achieved the synthesis of labeled compounds in 1957, while the production of radioisotopes started in 1962. The Jožef Stefan Nuclear Institute worked only on the synthesis of labeled compounds. (auth)

42587 PRODUCTION OF RADIOISOTOPES AND LABELLED COMPOUNDS AT THE BORIS KIDRIC INSTITUTE OF NUCLEAR SCIENCES. Teofilovski, Cedomir; Jezdic, Vojislav. Nukl. Energija, No. 2, 2-9(Apr. 1965). (In Slovenian).

Research associated with the production of radioisotopes was initiated in 1957. In early 1959 the hot chemistry laboratory was set up to cover the production of radioisotopes, and later the production of labeled compounds. For implementation of the program it was essential to have a number of problems solved: training of staff for work with radioisotopes at high activity levels; technology of material irradiation in the reactor; distribution of radioisotopes and labeled compounds; improvement of known and mastery of new methods for production of radioisotopes and sources of radiation requiring chemical treatment of targets; development and mastery of procedures for the production of labeled compounds; development of a method for the chemical, radiochemical, radiometric, and pharmaceutic control of the products obtained; designing, staffing, and equipping the laboratory; and designing and building of the necessary facilities and shielding for work with radioisotopes at distance and behind the shielding. The hot laboratory produces a number of radioisotopes requiring simple treatment after irradiation in the reactor, such as dissolution of irradiated targets, filtration of the solution, etc. These include radioactive solutions with the isotopes: ^{42}K, ^{24}Na, ^{45}Ca, ^{89}Sr, etc., which were obtained from the irradiated carbonates; ^{60}Co, ^{65}Zn, ^{110}Ag obtained by irradiation of pure metals; and ^{32}P with carrier, ^{141}Ce, and ^{59}Fe produced from irradiated oxides. However, the production of radioisotopes for application in medicine and some investigations requiring a pure radioisotope of high specific activity in most cases without carrier, is more complex. Therefore, their production is associated with a number of radiochemical separations. Work was carried out to make possible a permanent synthesis of a number of labeled compounds needed for research. First, work was conducted on the chemical synthesis of ^{14}C-labeled compounds, and later syntheses were initiated with ^{35}S and ^{32}P; now the synthesis is planned of compounds labeled with other radioisotopes such as ^{3}H, halogens, etc. Procedures were developed for the production of eighteen compounds labeled with ^{14}C, six ^{35}S-labeled compounds and five ^{32}P-labeled compounds. In addition to the production of radioisotopes and labeled compounds, distribution also had to be organized in view of the specific packing and shipment requirements for radioactive products. (M.C.G.)

42588 ISOTOPE PRODUCTION BY THE USE OF CYCLOTRON. Strohal, Petar. Nukl. Energija, No. 2, 10-13(Apr. 1965). (In Slovenian).

^{24}Na, ^{22}Na, ^{57}Co, ^{65}Zn, and ^{120}Sb are produced in the Ruder Bošković Institute, Zagreb. These radionuclides are of high specific radioactivity, normally produced without

carriers. Nuclear reactions, which take place during their production in the 15-Mev deuteron beams, are (d,α), (d,n), and (d,2n) with light, medium, and heavy nuclei, respectively. The (d,p) reaction is seldom used because products obtained by this reaction are identical to (n,γ) products obtained in a thermal neutron beam in the reactor. The Ruder Bošković Institute launched a program for production of radionuclides using the cyclotron. The construction of an ion source was planned, which would produce alpha particles of 32 Mev of energy. ^{83}Rb was the first radionuclide to be produced by alpha particles. The outer cyclotron beam was also to be put into effect. By setting the target behind the deflector the smaller current might produce radiation so that even powders can be irradiated: oxides, salts, and metals melting at low temperature, for instance. (auth)

42589 SYNTHESIS AND APPLICATION OF ^{14}C LABELLED COMPOUNDS. Keglevic, Dina. Nukl. Energija, No. 2, 14-16(Apr. 1965). (In Slovenian).

In 1954 a radioisotope laboratory was set up at the Ruder Bošković Nuclear Institute in Zagreb for work on the synthesis and application of ^{14}C compounds. The radioisotope laboratory endeavored to develop its activities in two directions: work on the synthesis of ^{14}C-labeled compounds for the needs of its own research, and for the needs of other laboratories in the country, and studies by ^{14}C tracer techniques of the metabolism of biologically interesting compounds. A whole series of labeled compounds, starting with simple ^{14}C compounds with one-carbon molecules, was prepared. Thus, from methyliodide-^{14}C, by a number of reactions, the following was obtained: L- and D-α-methionine-methyl-^{14}C, and L- and D-β-methionine-methyl-^{14}C. From $Ba^{14}CO_3$ through six reaction stages N-acetyl-DL-serine-β-^{14}C was synthesized and then enzymatically split into L- and D-serine-β-^{14}C. The amino acids were needed to study the process of biological methylation in plants and animals. From $Na^{14}CN$, as the starting substance, through several reaction stages the biogenic amine serotonine was synthesized labeled on the 1'-C atom of side chain. With serotonine a whole series of experiments in vivo and in vitro were conducted to obtain more knowledge on the metabolism and function of that amine in the organism. A simple method was developed for the preparation of 3,5-disubstituted indols. Furthermore, from $Ba^{14}CO_3$ α-naphthylisocyanate-^{14}C was synthesized. Ethyl α-naphthylureido-(^{14}C-carbonyl)-propionate, and ethyl β-naphthylureido-(^{14}C-carbonyl)-propionate were prepared. A procedure was worked out for the synthesis of the "symazin" labeled herbicide (2-chloro-4,6-bis-/ethylamine/-s-triasine). Starting out from $Na^{14}CN$ that compound was obtained through four reaction stages in a chain-labeled form. From $Ba^{14}Co$, novocaine was produced labeled with ^{14}C in the carboxyl group. It was often necessary to prepare as intermediate products some substances of interest for the investigation of other problems. (M.C.G.)

42590 A KINETIC STUDY OF THE ISOTOPIC EXCHANGE OF LUTETIUM BETWEEN THE LUTETIUM ION AND ITS ETHYLENEDIAMINE-N, N, N', N'-TETRA ACETATE. Asano, Takeyoshi; Okada, Satoshi; Sakamoto, Koh; Taniguchi, Setsuo; Kobayashi, Yasushi (Radiation Center of Osaka Prefecture). Radioisotopes (Tokyo), 14: 363-7(Sept. 1965).

The isotopic exchange reaction of lutetium between the uncomplexed lutetium ion and its EDTA complex was kinetically studied in a pH region from 6.5 to 5.5 by using lutetium-177 as a tracer. The rate is proportional to the first order of the concentration of both uncomplexed lutetium and its EDTA complex. The dependence of hydrogen ion concentration on the rate is very complicated. In the pH region from 6.5 to 6.0, the rate is independent on the concentration of hydrogen ion, and in the pH region below 6.0, clearly dependent on the hydrogen ion concentration. It may be supposed, therefore, that a possible mechanism for the exchange reaction in neutral solution is a simple displacement of the lutetium from the chelate compound by a collision with an uncomplexed lutetium. The rate of exchange is given by the expression: $R = 2.2 \times 10^{-2}[Lu\text{-}EDTAOH_2^-][Lu^{3+}]$ mole $l^{-1}\cdot min^{-1}$. In acid solution, the acid catalized reaction may compete with the bimolecular reaction. (auth)

Separation Processes and Procedures

See also Analytical Procedures
ISOTOPE TECHNOLOGY — Separation and Production

42591 (AAEC/E-139) DEVELOPMENT OF SOLVENT EXTRACTION PROCESSES FOR THE H.T.G.C.R. FUEL CYCLE. PART 1. DESIGN OF A FLOWSHEET FOR THE RECOVERY OF ACTINIDES. Baillie, M. G.; Ryan, R. K. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). June 1965. 36p. Dep. mn.

A preliminary flowsheet for the recovery and decontamination of residual actinides in spent H.T.G.C.R. fuel was designed. A calculation method for the multicomponent liquid–liquid extraction system $H_2O-UO_2(NO_3)_2-Th(NO_3)_4-Be(NO_3)_2-HNO_3-TBP$–kerosene using the limited equilibrium data available is described. The flowsheet which was designed incorporates a novel "split contactor" concept which is necessary to prevent third phase problems. (auth)

42592 (AERE-R-4888) THE EXTRACTION OF NITROSYLRUTHENIUM NITRATO COMPLEXES FROM NITRIC ACID SOLUTIONS BY DIBUTYL CELLOSOLVE AND BUTEX. Scargill, D.; Lyon, C. E.; Wain, A. G. (Atomic Energy Research Establishment, Harwell (England)). June 1965. 18p. Dep.; BIS $0.70; HMSO 3s. 6d.

Partition coefficients of the extractable nitrosylruthenium nitrato complexes were determined between aqueous nitric acid solutions and the ethers dibutyl cellosolve and Butex. The tetranitrato complex is the most extractable by both these solvents, but, whereas dibutyl cellosolve is a comparatively weak extractant, the extractability of the tetra- and trinitrato complexes by Butex is similar to that of about 35% tri-n-butyl phosphate. The rate constants found for the nitration and aquation reactions between the tetranitrato and trinitrato complexes in the dibutyl cellosolve and Butex phases are comparable to those found for these reactions in aqueous nitric acid solutions. (auth)

42593 (BNWL-SA-273) SEPARATION OF ALKALI METALS BY SOLVENT EXTRACTION WITH MIXTURES OF ORGANIC-SOLUBLE ACIDS AND PHENOLS. Keder, W. E.; Martin, E. C.; Bray, L. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). July 27, 1965. Contract AT(45-1)-1830. 17p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Alkali metal ions can be separated by extraction with di(2-ethylhexyl) phosphoric acid in hydrocarbon solutions. The order of extractability is $Li^+ > Na^+ > K^+ > Rb^+ > Cs^+$. Addition of 4-sec-butyl-2(α-methylbenzyl) phenol reverses this extractability order. Physical chemical studies on the molecular species involved in this extraction are discussed, the reasons for the extractability order are postulated, and some experiments described concerning the effect of modification of the phenol molecule. (auth)

42594 (DP-344) BEHAVIOR AND IDENTIFICATION OF EXTRACTABLE RUTHENIUM. Pollock, Henry; Wallace, Richard M. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. Savannah River Lab.). Mar. 1959. Contract AT(07-2)-1. 26p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Ruthenium exists as several species in Purex feed. The more extractable of these species limit the separation of ruthenium from uranium and plutonium. The extractable species were shown to contain the nitrosylruthenium (RuNO) complex and to react in a manner very similar to species of the nitrato nitrosylruthenium $[RuNO(NO_3)_{(3-x)}(OH)_x(2H_2O)]$ system. (auth)

42595 (NIJS-R-450) SEPARATION OF Tc(VII) FROM IRRADIATED MoO_3 SAMPLE BY SOLVENT EXTRACTION WITH TRI-ISO-OCTYLAMINE. Klofutar, C.; Stular, V.;

Krasovec, F. (Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia)). May 1965. 8p. Dep. mn.

An solvent extraction method for the separation of technetium and molybdenum is outlined. After irradiation of MoO_3 and dissolution in sodium hydroxide, the shortlived ^{99m}Tc isotope is extracted from 1M HCl into a solution of TIOA in 1,2-dichloroethane. The percentage of ^{99}Mo in organic phase is less than 0.5%. (auth)

42596 (NP-15130) VERSUCHE ZUR SCHAELLEN TRENNUNG DER SELTENEN ERDEN DURCH FOKUSSIERENDEN IONENAUSTAUSCH. (Research on the Fast Separation of Rare Earths Through Focussing Ion Exchange). Knolle, Karlfried (Mainz Univ. (West Germany). Naturwissenschaftliche Fakultaet). 1963. 138p. Dep. mn.

The focusing ion exchange method or the electrophoretic ion focusing method was studied for its applicability to the fast separation of the rare earths. The systems Pm–Tm, Eu–Tb, Eu–Tm, Tb–Tm, and Sr–Y–Tb (or Tm) were studied as a function of the parameters anode space solution, cathode space solution, duration of the focusing, and applied voltage. The separations were not quantitative, but for qualitative fast separations the method is in the critical evaluation of focusing with the help of a γ spectrum a usable means. (J.S.R.)

42597 (NP–15311(Vol.I)(Pt.B)) SAFETY ANALYSIS [OF] SPENT FUEL PROCESSING PLANT. PART B OF LICENSE APPLICATION. VOLUME I. (Nuclear Fuel Services, Inc., Washington, D. C.). July 1962. 447p. (DOCKET–50-201). Public Reading Room AECW.

A summary is given of the information presented in the two volumes. A description is given of the site, plant, process, and equipment. (D.L.C.)

42598 (NP–15311(Vol.II)(Pt.B)) SAFETY ANALYSIS [OF] SPENT FUEL PROCESSING PLANT. PART B OF LICENSE APPLICATION. VOLUME II. (Nuclear Fuel Services, Inc., Washington, D. C.). July 1962. 269p. (DOCKET–50-201). Public Reading Room AECW.

As part of the safety analysis, an engineering analysis of the plant was performed. The analysis includes ventilation, sampling and analysis, maintenance, shielding, monitoring system, utilities, and criticality. (D.L.C.)

42599 (NP–15312) APPLICATION FOR LICENSES FOR A SPENT FUEL PROCESSING PLANT. SUBMISSION NO. 15—FINAL SAFETY ANALYSIS REPORT. REVISION OF SECTION VII—PROTECTION OF THE PUBLIC. (Nuclear Fuel Services, Inc., Washington, D. C.). Aug. 20, 1964. 394p. (DOCKET–50-201). Public Reading Room AECW.

The plant and process have been designed so that under normal operation or maximum credible accident conditions, the radioactivity release to the environment is less than the limits set by 10 CFR Part 20 and 10 CFR Part 100, respectively. Analyses of the possible radioactivity releases and hazards are presented. (D.L.C.)

42600 (NP–15342) STUDIES OF THE SORPTION OF RADIOISOTOPES ON MARINE SEDIMENTS. Final Report. Hamaguchi, Hiroshi (Japan Analytical Chemistry Research Inst., Tokyo). Dec. 28, 1963. Contract IAEA 88/R2/RB. 141p. Dep mn.

Adsorption of ^{134}Cs, ^{90}Sr, ^{60}Co, ^{152}Eu, and ^{154}Eu was studied on terrigenous sediment and Pacific red clay. Assumption was made on the possibility of hindrance of fixed potassium on the adsorption of cesium and on the proportionality, as a consequence, of the distribution coefficients and the ratio of exchangeable potassium to total potassium. The assumption was confirmed by the plot of distribution coefficients vs. the ratio of exchangeable potassium to the total potassium, which resulted in straight lines for the same samples of the same origin. It was also found that the distribution coefficients and the ratio of exchangeable magnesium to the total magnesium showed the same relation. The probable cause of these effects are discussed. Application of the mass action law to the exchange reaction of these isotopes at extremely low concentrations on the marine sediments showed that the calculated equilibrium constants actually varied with the external solution concentration. Exchange equilibrium constants and the solid phase activity coefficients were determined for the exchange reaction on red clay by the method of Gaines and Thomas. The method of Freeman was applied to the cation exchangers for Ca–Co and Mg–Eu systems, where the logarithms of the equilibrium quotients varied linearly with exchange capacity. Equilibrium studies were made on Na-, K-, Mg-, and Ca-substituted red clay. (auth)

42601 COMPARATIVE STUDY OF THE FORMATION, BY ELECTROLYSIS, OF AMALGAMS OF RARE EARTHS AND ACTINIUM. David, Francois; Bouissieres, Georges (Universite de Paris, Orsay, France). Bull. Soc. Chim. France, No. 4, 1001-7(Apr. 1965). (In French).

Since the amalgamation, in citric acid medium, of rare earths and actinium by electrolysis on a lithium amalgam cathode is a reaction of the first order, the periods of amalgamation for various concentrations of lithium citrate solutions were compared. The results obtained can be interpreted by admitting that the elements studied have a valence 2, more or less stable; the stability of Ac^{2+} is close to that of Sm^{2+}. The differences in behavior of the rare earths and actinium make it possible to predict some separation of these elements. (tr-auth)

42602 ELECTROPHORESIS OF URANYL SALTS. Bachelet, Maurice; Carpentier, Jean-Marie (Faculte des Sciences, Mont-Saint-Aignan, France). Compt. Rend., 260: 6622-3(June 21, 1965). (In French).

The electrophoresis of uranyl salts, in solution in the hydrates of fused salts, was carried out on glass-fiber paper. The displacement of uranium, contrary to that observed in aqueous solution, was toward the anode in fused $CaCl_2 \cdot 6H_2O$, $LiNO_3 \cdot 3H_2O$, and $Na_2CrO_4 \cdot IOH_2O$. (tr-auth)

42603 PURIFICATION OF HEAVY WATER CONTAMINATED WITH OIL. Paul, S. D.; Ganesan, M.; Gaonkar, D. G.; Gupta, D. (Atomic Energy Establishment, Trombay, India). Indian J. Technol., 3: 232-3(July 1965).

Heavy water contaminated with light oil on shaking with or passing through a column of powdered activated charcoal is completely separated from the oil; 1 g charcoal is sufficient to purify 750 ml of oil-saturated water. The inorganic impurities introduced from the charcoal are completely removed by a single distillation in a quartz apparatus. A set-up capable of purifying contaminated water in 30 liter batches was fabricated. (auth)

42604 SEPARATION OF ^{18}O-LABELED NITRITE FROM PHOSPHATE BY ION-EXCHANGE CHROMATOGRAPHY UNACCOMPANIED BY CATALYSIS OF ISOTOPE EXCHANGE. Rees, M.; Nason, A. (Johns Hopkins Univ., Baltimore). Intern. J. Appl. Radiation Isotopes, 16: 495-6 (Aug. 1965).

Chromatographic separation of oxygen-18-labeled nitrite from phosphate was studied. It was found that Dowex 1, a strongly basic ion-exchange resin, had no effect on the rate of isotope exchange between nitrite and water. The isotopic composition of nitrite, which has an easily exchangeable oxygen, was unaltered by the resin. There was a 13% loss of label in the control $NaN^{18}O_2$ and an identical loss of ^{18}O content in the chromatographed sample. (F.J.H.)

42605 REPROCESSING OF SPENT FUELS, DEVELOPING THORIUM CYCLE COULD CUT CANDU COSTS. Mod. Power and Engineering, 59: 90-1(June 1965).

The economic advantages of recovering Pu and using it as a spike material in thorium-uranium fuels was examined. A moderator temperature in the 100°C range of CANDU-type reactors makes such a plan attractive by increasing the burnup as much as 15 times in the thorium cycle. (F.S.A.)

42606 ENGINEERING DEVELOPMENT OF A FLUIDBED FLUORIDE VOLATILITY PROCESS. II. PILOT-SCALE STUDIES. Holmes, John T.; Stethers, Howard; Barghusen, John J. (Argonne National Lab., Ill.). Nucl. Appl., 1: 301-9(Aug. 1965).

As a step in the development of a reprocessing method for spent nuclear fuels, a fluoride volatility pilot plant

successfully demonstrated the recovery of uranium as uranium hexafluoride from unirradiated uranium–zirconium and uranium–aluminum alloy fuels. The process involves the separation of the alloying metal as a volatile chloride by reaction with hydrogen chloride in a fluid-bed reactor, followed by reaction of residual solid uranium chlorides with hydrogen fluoride and then with fluorine gas to effect recovery of uranium hexafluoride. In tests involving the processing of up to 30 kg of simulated fuel, uranium recoveries of >99% were achieved. The volatile zirconium and aluminum chlorides are converted to solid oxides for waste disposal by reaction with steam in a fluid-bed reactor. (auth)

42607 HYDROGEN REDUCTION OF Pu(IV) TO Pu(III). Rainey, Robert H. (Oak Ridge National Lab., Tenn.). Nucl. Appl., 1: 310-11(Aug. 1965).

Experiments showed that 4% H_2–96% Ar may be used as the reducing agent for Pu(IV) in the Purex system. The use of hydrogen instead of ferrous sulfamate would eliminate almost two-thirds of the oxides from the aqueous waste and simplify waste treatment. (M.C.G.)

42608 SEPARATE EXTRACTION OF THORIUM AND PROTACTINIUM. Rudenko, N. P.; Saed, Abdel Gavad; Lapitskaya, L. V. Radiokhimiya, 7: 32-3(1965). (In Russian).

Experiments carried out on protactinium and thorium separation using N-benzoylphenylhydroxylamine and neocupferron resulted in 100% Pa extraction by N-benzoylphenylhydroxylamine followed by re-extraction with 5M hydrofluoric acid and in 90% extraction of Pa by neocupferron in chloroform with re-extraction by 10M hydrochloric acid. It was also found that during Pa extraction by neocupferron in chloroform thorium does not shift into the organic form. (R.V.J.)

42609 IMPROVEMENTS RELATING TO THE TREATMENT OF SPENT FUEL ELEMENTS FROM ATOMIC REACTORS. Tjalldin, Olle (to Aktiebolaget Atomenergi). British Patent 997,355. July 7, 1965. Priority date Jan. 18, 1962, Sweden.

A method is described for treating spent fuel elements consisting of a uranium fuel enclosed in a capsule mainly of Zr from nuclear reactors. The element is heated at a temperature of at least 700°C in an atmosphere of steam and N_2 with or without O_2 for a time sufficient to transform the capsule into ZrO_2. The element is then heated at a temperature of 300–600°C in an atmosphere substantially consisting of O_2 for a time sufficient to transform the uranium fuel into U_3O_8. Finally, the combined Zr and U oxides are leached with a dilute aqueous solution (4–4.5 moles/l) for a time sufficient to dissolve the U_3O_8. (B.L.M.)

42610 METHOD FOR DECONTAMINATING NUCLEAR FUELS CONTAINING RUTHENIUM COMPLEXES. Wallace, R. M. (to U. S. Atomic Energy Commission). U. S. Patent 3,208,819. Sept. 28, 1965.

A method is given for improving the decontamination of neutron-irradiated nuclear fuels from their fission products in aqueous solutions by adding barbituric acid to the aqueous solution and digesting the same at elevated temperature prior to solvent extraction or ion exchange. The barbituric acid improves decontamination of uranium and plutonium from ruthenium by complexing the ruthenium prior to solvent extraction or ion exchange from an aqueous acid solution. (auth)

ENGINEERING

General

42611 ADVANCES IN CRYOGENIC ENGINEERING. VOLUME 10. Proceedings of the 1964 Conference, Univ. of Pennsylvania. Section A-L. Timmerhaus, K. D. (ed.). New York, Plenum Press, 1965. 438p. $17.50. (CONF-554).

Separate abstracts were prepared for four of the 62 papers included. Six papers were previously abstracted for NSA (18: 29923, 33804, 40978, 40979, 43748; and 19: 18105). The remaining papers deal with the properties of materials, ortho-parahydrogen catalysis, insulation, instrumentation, safety, cryopumping, fluid phenomena, equipment development, seals, and miniature refrigerators. (D.C.W.)

For abstracts of individual papers see: 42808, 42857, 43232, and 43589.

42612 INTERNATIONAL ADVANCES IN CRYOGENIC ENGINEERING. Proceedings of the 1964 Conference, Univ. of Pennsylvania, Philadelphia. Section M-U. Timmerhaus, K. D. (ed.). New York, Plenum Press, 1965. 524p. $17.50. (CONF-554).

Separate abstracts were prepared for eight of the 42 papers included. Six other papers were previously abstracted for NSA (18: 39627, 40981, 41758, 44675; and 19: 12037, 23232). The remaining papers deal with refrigeration, applications of superconductivity, thermodynamics, bubble chambers, fluid pressurization and stratification, heat transfer, and European equipment development. (D.C.W.)

For abstracts of individual papers see: 42613–42615, 42618–42619, 42735, and 43233.

42613 A PULSED REFRIGERATION SYSTEM FOR CRYOGENIC MAGNET APPLICATION. Strobridge, T. R.; Mann, D. B. (CELD National Bureau of Standards, Boulder, Colo.). Intern. Advan. Cryog. Eng., 10: 54-61(1965).

An analysis of the performance of a refrigeration system designed to absorb a pulsed load is summarized. The following refrigeration requirements were used: a maximum magnet temperature of 10°K, a cycle time of 10 min, a minimum time of 1 min at steady-state field intensity, and an energy release of 5×10^6 J by the magnet at steady-state field intensity. (D.C.W.)

42614 THE GENERATION OF HEAVY CURRENTS IN SUPERCONDUCTING CIRCUITS. Volger, J. (Philips' Gloeilampenfabrieken, N. V., Eindhoven, Netherlands). Intern. Advan. Cryog. Eng., 10: 98-104(1965).

The principles of superconducting current generators are outlined, together with various forms of such generators. The performance of superconducting dynamos is then discussed. (D.C.W.)

42615 A SIX-FOOT LABORATORY SUPERCONDUCTING MAGNET SYSTEM FOR MAGNETIC ORBITAL SATELLITE SHIELDING. Hawkins, S. R. (Lockheed Missiles and Space Co., Palo Alto, Calif.). Intern. Advan. Cryog. Eng., 10: 124-36(1965).

A superconducting magnet system designed for shielding a space vehicle in the artificial radiation belt is described. The design calculations are summarized, together with the observed performance of the 6-ft magnet system and a prototype 2-ft magnet system. (D.C.W.)

Facilities and Equipment

Refer also to abstract 42390.

42616 (AERE-R-4933) A LEAD SHIELDED CELL FOR HANDLING $\beta\gamma$-ACTIVE MATERIALS. Brown, P. E. (Atomic Energy Research Establishment, Harwell (England)). May 1965. 21p. Dep.; BIS $0.70; HMSO 3s. 6d.

A versatile lead shielded cell is described together with the equipment and operating experience gained in the chemical remote handling of active materials at levels up to 10 Mev curie of γ activity. (auth)

42617 (TID-22102) VIRUS CONTROL LABORATORY — [OAK RIDGE NATIONAL LABORATORY, BUILDING 9220 Y-12 PLANT]. Title I Report. (Kinney (A. M.) Inc., Cincinnati, Ohio). June 11, 1965. Contract AT(40-1)-2970. 132p. Dep. mn; CFSTI $4.00 cy, $1.00 mn.

A general outline is presented of the design, construction, a preliminary schedule, the proposed method of accomplishment, and the estimated cost of a virus control laboratory for the ORNL Biology Division. Preliminary drawings, outline specifications, and other descriptive matter are included. (D.L.C.)

42618 DEVELOPMENT OF A HIGH-PURITY NITROGEN PLANT USING EXPANSION TURBINES WITH GAS BEARINGS. Beasley, S. A. (Lucas Industrial Equipment, Ltd., Liverpool); Halford, P. Intern. Advan. Cryog. Eng., 10: 27-39(1965).

The development of a nitrogen production plant for which it was specified that the purity should be better than 200 ppm of oxygen is outlined, including the plant design philosophy and the effect which the expansion turbine had on the design considerations. Operating experience with a number of plants of this type is summarized. (D.C.W.)

42619 SELECTED EXAMPLES OF EUROPEAN CRYOGENIC DESIGN PRACTICE. Kanoldt, W. (Gesellschaft fuer Linde's Eismaschinen A.G., Hoellriegelskreuth, Ger.). Intern. Advan. Cryog. Eng., 10: 393-404(1965).

Some examples of European cryogenic design practice are discussed including large air and gas separation plants, helium and hydrogen liquefiers, gas purification plants for reactors, and components for low-temperature plants. (D.C.W.)

42620 ROTARY SHAFT CONSTRUCTION WITH DIAPHRAGM TYPE OF SEAL. Hutter, Ernest; Elias, Peeter (to U. S. Atomic Energy Commission). U. S. Patent 3,208,289. Sept. 28, 1965.

A construction is designed in which a rotary shaft is formed in separate aligned sections with an oscillating eccentric connection between them, whereby the shaft may be sealed by a diaphragm seal. The eccentric connection includes a shiftable plate engaging the diaphragm seal. The significant thing is that the shiftable plate is held against rotation while being shifted back and forth and so the wear on the diaphragm seal is held to a minimum. The shiftable plate is held against rotation by means of two sets of diametrically opposed bearing members located at opposite sides of the shiftable plate and two sets of diametrically opposed openings loosely receiving the bearing members for rolling contact therewith, the openings being formed in two stationary plates located at opposite sides of the shiftable plate so as to confine the shiftable plate to movement in its own plane. (AEC)

42621 INSULATED TUBE COUPLING. Boudrie, Warren E. (to U. S. Atomic Energy Commission). U. S. Patent 3,208,773. Sept. 28, 1965.

An electrically insulated high pressure tube coupling is designed which utilizes a gland and collar means connected to each tube in combination with a seal and threaded block to provide a continuous opening of a constant diameter from the inner surface of one tube to the inner surface of the other tube. (AEC)

Heat Transfer and Fluid Flow

See also PHYSICS — General.

42622 (AD-426393) A STUDY OF DIFFUSION IN A CHEMICALLY FROZEN IONIZED GAS. Howard, Stanley G.

(TRW Space Technology Labs., Thompson Ramo Wooldridge Inc., Redondo Beach, Calif.). Nov. 1963. 45p. CFSTI $5.60 cy, $0.50 mn.

Heat transfer in an ionized gas is studied by comparing the results given by different diffusion models. The analysis is valid for ionized gases in which the Debye length exceeds a mean free path. Multicomponent diffusion coefficients are employed in the equations to describe exactly the heat transfer in a highly ionized gas at rest between two walls maintained at different temperatures. A simplified model is developed which is valid for weakly ionized gases, and the ambipolar diffusion model is derived when the assumption of no charge separation is made. Solutions for these models are obtained on a digital computer for various wall separations and compared with each other and with an analytic solution of the ambipolar diffusion model. It is concluded that, for problems in which the wall separation is large compared with the Debye length, the ambipolar model is adequate in predicting the heat transfer and the flux of charged particles. (auth)

42623 (EURAEC-1363) IMPROVEMENT OF HEAT TRANSFER IN BWR. Quarterly Report No. 20. (Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Sureanes (France). Division Atomique). Apr. 20, 1965. Contract 061-64-7 TEEF. 7p. (EUR-2338). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Work Performed under United States-Euratom Joint Research and Development Program.

Heat transfer improvement tests were carried out for Boiling Water Reactors. A brief discussion of the hydrodynamic and thermal tests which were carried out is included. Results from these tests are presented. (M.O.W.)

42624 DYNAMIC ANALYSIS OF COOLANT CIRCULATION IN BOILING-WATER NUCLEAR REACTORS. I. Sanathanan, C. K.; Carter, J. C.; Miraldi, F. Nucl. Sci. Eng., 23: 119-29(Oct. 1965).

The dynamics of two-phase flow through the coolant channels of a natural-circulation boiling-water nuclear reactor is studied analytically. One-dimensional conservation equations describing the flow through each channel are written in the linearized perturbed form, and Laplace transformation in time is performed. A systematic procedure is developed to approximate the solution. The solution may, in general, be oscillatory both in time and in space. Since the space dependence of the transient steam void fraction is available, it may be multiplied by its reactivity worth to obtain the space-time-dependent void reactivity. The transfer function expressing the relation between the void fraction or velocity of water and the heat flux may be conveniently used to understand the hydrodynamic stability. The analytical techniques developed are applicable to both natural- and forced-circulation systems. (auth)

42625 DYNAMIC ANALYSIS OF COOLANT CIRCULATION IN BOILING-WATER NUCLEAR REACTORS. II. Sanathanan, C. K.; Carter, J. C. Miraldi, F. Nucl. Sci. Eng., 23: 130-7(Oct. 1965).

Mathematical techniques were developed to investigate the dynamics of coolant circulation in boiling-water nuclear reactors. An attempt is made to apply those techniques to various specific situations. A natural-circulation loop with a single heated channel is considered first. Dependence of the degree of stability upon the steady-state profile of the channel heat flux and the channel length are investigated. The influence of the pressure drops in the downcomer and at the channel inlet upon the transient two-phase flow is studied. The steady-state perturbations in the void fraction and velocity due to a small perturbation in the channel heat flux are predicted. The findings of the present study compare favorably with those obtained by the simplifying assumption made by the earlier investigators that the slip ratio is a constant along the channel length. The more interesting system with two or more channels operating in parallel with a common downcomer is considered next. The strength of the coupling between the dynamics of the flows through the channels increases with the pressure drop in the common downcomer, and this phenomenon is considered quantitatively. Results obtained theoretically are substantiated by comparison with those obtained through elaborate numerical methods and previous observations. (auth)

42626 TURBULENCE ENERGY PRINCIPLES FOR QUASI-NORMAL AND WIENER-HERMITE EXPANSIONS. Meecham, William C. (Univ. of Minnesota, Minneapolis). Phys. Fluids, 8: 1738-9(Sept. 1965).

It is shown that the quasi-normal assumption can lead to energy conservation in the transfer term if the velocity field components are treated symmetrically. It is also noted that the use of the Wiener-Hermite representation leads to energy-conserving approximations. (D.C.W.)

Materials Testing

42627 (EURAEC-1406) THE WELDING OF VERY THICK STEELS. MARGIN OF UNCERTAINTY OF THE ROBERTSON TEST. Special Report No. 7. (Ghent Rijksuniversiteit (Belgium); Soudometal, S. A., Brussels (Belgium)). May 20, 1965. Contract 042-61-9 RDB. 22p. (EUR-2365). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Work Performed under United States-Euratom Joint Research and Development Program.

Tests were performed to determine the uncertainty zone of the Robertson test. A temperature zone in which the result is governed by an uncertain probability was observed. By applying the maximum probability method it is possible to evaluate the extent of this zone for the case in question, but this evaluation is very indeterminate. In addition, the conclusions drawn from the tests described are only valid a priori for the type of steel tested. It is concluded from these tests that the brittle fracture criteria based on the large-scale tests are affected by an uncertainty zone that cannot be neglected. The comparison of test results is in danger in many cases of producing conclusions which could be unfounded and be the result of fortunate or unfortunate chance during the tests. (auth)

42628 NEW TECHNIQUES OF UTILIZATION OF RADIOELEMENTS IN GAMMAGRAPHY OF WELDS AT THE GAZ DE FRANCE. Ruault, P.-A. Bull. Inform. A.T.E.N. (Assoc. Tech. Energie Nucl.), No. 53, Suppl., 3-9 (May-June 1965). (In French).

The gammagraphic detection of faults in welds using ^{192}Ir was investigated. The effects of the principal parameters and of the blurred geometric image were considered. An example is given of the practical application of this method. Safety precautions for use of the γ source and personnel monitoring procedures are discussed. It was concluded that the ^{192}Ir γ source will satisfactorily detect and locate faults under conditions that are safe for the user. (J.S.R.)

42629 PENETRATING RADIATION AS AN ENGINEERING TOOL. Burr, Arthur A. (Rensselaer Polytechnic Inst., Troy, N. Y.). Mater. Evaluation, 23: 329-34(July 1965).

Using a simple basic model, the fundamental mechanisms for the interaction of radiation and matter are classified. The history of the development of these mechanisms and their impact on engineering from the standpoint of materials evaluation are briefly developed, and a review is presented of the state of the art. The role of the engineer as it developed in this field, and some of the implications for the future, are discussed in the perspective of future needs in the evaluation of materials. (auth)

Space Propulsion

See also REACTOR TECHNOLOGY — Propulsion and Space.

42630 (NP-15333) CYCLOTRON RESONANCE PROPULSION SYSTEM. Monthly Progress Report No. 8, June 1965. Miller, David B.; Bethke, George W. (General Electric Co., Philadelphia, Pa. Missile and Space Div.). July 2, 1965. Contract NAS 3-6266. 16p.

R-f electric probes, magnetic probes, energy-analyzing devices, and potential probes for use in a short, peripheral-injection, propulsion accelerator are described. (T.F.H.)

42631 ISOTOPE MICROTHRUSTER PROPOSED BY PHILCO. Aviat. Week Space Technol., 83: 35-6(July 12, 1965).

A microthruster designed to produce thrusts of 10^{-11} to 10^{-5} lb for periods of a year or more is described in which hydrogen released from a metal hydride by decay heating escapes through a nozzle on the thermally insulated pressure shell containing the metal hydride and isotopic heat source. (D.C.W.)

42632 HIGH THRUST NUCLEAR PROPULSION IN AERONAUTICS AND ASTRONAUTICS; BIBLIOGRAPHIC CONTRIBUTION. D'elia, Giovanni (Universita, Naples). Ing. Nucl., 6: 92-107(Mar.-Apr. 1965). (In Italian).

A survey is presented on high-thrust nuclear propulsion. As an introduction to the bibliography, a brief history is given of the principal research programs. 435 references. (J.S.R.)

Vacuum Engineering

42633 DESIGN AND PERFORMANCE OF A GETTER-ION PUMP. Nambiar, K. B.; Divatia, A. S. (Atomic Energy Establishment, Trombay, India). Indian J. Pure Appl. Phys., 3: 271-2(July 1965).

A getter-ion pump in which titanium is evaporated by electron bombardment was built and its performance when connected to a metal system was tested. The lowest pressure achieved by this pump is $\sim 2 \times 10^{-7}$ mm. Hg. Its pumping speed is comparable to that of a 2-in. mercury diffusion pump. (auth)

GEOLOGY AND MINERALOGY

General

Refer also to abstracts 42443 and 42451.

42634 (YALE–2912–10) TRACE ELEMENTS IN SEA WATER. Annual Progress Report, December 1, 1964–November 30, 1965. Geochemistry Technical Report No. 11. Turekian, Karl K. (Yale Univ., New Haven, Conn. Dept. of Geology). Aug. 31, 1965. Contract AT(30-1)-2912. 62p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

The concentrations of cobalt, nickel, and silver, determined by neutron activation analysis, are systematically lower in the east Pacific sector of the Antarctic Ocean relative to other oceanic areas. This is indicated by two traverses between 70°S and 54°S at 115°W and about 90°W. Transport of cobalt, nickel, and silver from the Pacific Ocean to the Atlantic Ocean via the Drake Passage is thus minimal. Calculations based on the silver concentration in Pacific and Antarctic waters and Antarctic sediments indicate that a flow rate 1% of that predicted for the transport of Pacific Deep Water is consistent with the data. The solution of glacial flour may be responsible for the relatively high concentrations of cobalt and nickel encountered at the closest approach to the Antarctic continent. (auth)

42635 STRONTIUM ISOTOPE INVESTIGATION OF IGNEOUS ROCKS FROM ICELAND. Noorbath, S. (University Museum, Oxford); Walker, G. P. L. Nature, 207: 837–40(Aug. 21, 1965).

Strontium isotope measurements are reported for a small, but reasonably representative, set of basic and acid igneous rocks of Tertiary to Recent age from a number of localities in Iceland. The rock types include gabbro, basalt, andesite, basic, and acid tuff, pitch-stone, obsidian, and granophyre. Measurements were carried out either on powdered, whole rock specimens, or on plagioclase feldspar separates. With one exception there was no significant difference in the $^{87}Sr/^{86}Sr$ ratio between any of the rocks measured. The mean value for 12 basic rocks is 0.7024 ± 0.0009 and for 11 acid rocks 0.7016 ± 0.0008. The results suggest that the relatively few acid rocks from Iceland so far investigated are ultimately derived from the same source region as the basic rocks, presumably the upper mantle. The acid rocks were formed either by the fractional crystallization of basic magma or by some process of partial melting of basic rocks. Other results are discussed. (P.C.H.)

Natural Radioactivity and Fallout

See also HEALTH AND SAFETY.

Refer also to abstracts 42248–42249, and 42424.

42636 (AD–609645) MIGRATION OF FUSED FALLOUT SIMULANT INTO SOILS. Hanna, Alfred E. (Naval Civil Engineering Lab., Port Hueneme, Calif.). Jan. 16, 1964. 16p. (TN–563). CFSTI $1.00 cy, $0.50 mn.

Results are reported from a study of the migration of fused fallout simulant into alternately frozen and thawed soils. Four different soils or soil mixtures were used; Monterey sand treated with Barium-140 and sodium silicate was the fallout simulant. Radiation levels were measured after each of twelve thaw-freeze cycles. It was concluded that the fused fallout simulant did not migrate into the soils. Further work is recommended using actual fallout debris. (auth)

42637 (BIO/32/63) DATA ON ENVIRONMENTAL RADIOACTIVITY COLLECTED IN ITALY (JANUARY–JUNE 1963). (Comitato Nazionale Energia Nucleare, Rome (Italy)). Nov. 1963. 228p. (A/AC.82/G/L.982). Dep. mn.

Data are presented on the level of environmental radioactivity due to fallout at various stations throughout Italy in 1963. Comparative data collected since 1956 are included. Data are included on the gross β activity in samples of atmosphere, precipitation, surface waters, drinking waters, soil, and foods. Milk samples were analyzed for ^{137}Cs, ^{131}I, ^{89}Sr, and ^{90}Sr, and drinking water samples were analyzed for ^{89}Sr and ^{90}Sr. Measurements were also made on the radioactivity of fish, plankton, and invertebrates from various lakes throughout Italy. (C.H.)

42638 (HASL–163) THE HASL BONE PROGRAM, 1961–1964. Rivera, Joseph; Harley, John H. (Health and Safety Lab., New York Operations Office (AEC), N. Y.). Aug. 16, 1965. 75p. Dep. mn; CFSTI $2.50 cy, $0.75 mn.

The bone program carried out at HASL from 1961 through 1964 has furnished data on the levels of strontium-90 in four locations, and established certain metabolic patterns and parameters for understanding and predicting the metabolism of strontium-90 in man. Like any body of similar data it has cumulative advantages in that more information may be extracted from the data as they accumulate. Some of the effects studied can be large in themselves but still produce only small year-to-year changes in the concentration of strontium-90 in bone. The ability to group data of several years and to analyze the course of the information obtained should lead to additional understanding of mechanisms of bone uptake and turnover. The use of an established sampling system for additional studies is also very attractive. The samples have already been used for radium-226 studies and comparable sets of measurements on certain other natural radionuclides are planned. In addition, metabolic information might also be obtainable by measurement of certain stable elements in both diet and bone samples. These would appear to be feasible since the data obtained in the strontium-90 program indicate that a valid relationship exists between the HASL diet sampling and the bone sampling. (auth)

42639 (NP–15278) RADIOACTIVITY SURVEY DATA IN JAPAN. No. 4. (National Inst. of Radiological Sciences, Chiba (Japan)). Aug. 1964. 31p. Dep. mn.

Data are presented on the content of ^{137}Cs and ^{90}Sr in samples of atmospheric dusts, precipitation, surface waters, water supplies, soil, total diet, food, milk, and deciduous teeth collected at various locations in Japan during Aug. 1964. (C.H.)

42640 (NP–15326) A STUDY OF NUCLEAR DEBRIS IN THE UPPER ATMOSPHERE. Edvarson, K.; Loew, K. (Forsvarets Forskiningsanstalt, Stockholm (Sweden)). Apr. 1965. 18p. Dep. mn.

A method for determining the time of origin and relative contribution of the different components in debris from nuclear explosions is described. The method was applied to a number of samples taken over Sweden in autumn 1962 and spring 1963. (auth)

42641 (TID–22112) TREND OF GROSS BETA RADIOACTIVITY IN PLANKTON SAMPLES COLLECTED IN THE ADRIATIC AND LIGURIAN-TYRRHENIAN SEAS DURING 1961–1964. Triulzi, Cesare (Centro Informazioni Studi Esperienze, Milan (Italy)); Tassi-Pelati, Laura (Parma Univ. (Italy). Istituto di Zoologia e Anatomia Comparata). 1965. Contract AT(30-1)-2607. 17p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Gross beta radioactivity was measured on plankton ash samples collected in the Ligurian-Tyrrhenian Sea and Upper Adriatic during 1961 to 1964. The trend of gross beta radioactivity during this period is correlated with rainfall and radioactive fallout in the same zone. Values of gross beta are reported that were measured 15 and 200 days after the tow. The ratio between the values supplies a useful indication on the date of nuclear explosions responsible for sample contamination. (auth)

42642 THE APPEARANCE OF ATOMIC FISSION PRODUCTS ISSUING FROM THE ATMOSPHERICAL NUCLEAR WEAPON TEST OF 16th OCTOBER, 1964, IN THE DEBRECEN RAINFALL. Kovach, Adam. At. Kozlemen., 7: 57-62(Mar. 1965). (In Hungarian).

The atmospherical nuclear weapon test, made in the territory of the Chinese People's Republic on 16th October, 1964, did not noticeably increase the level of radioactivity of the rainfall in Debrecen. But at the same time, on the basis of the relative rise of the specific activity of the rainfalls as well as by reason of the measurement of the decay of the fission products the presence of the fission products, issuing from this experiment, was traceable in the rainfall of November, 1964. On the basis of certain indications the conclusion can be drawn that the rainfall of 25th October 1964,—in a very little quantity—might have contained fission products of tropospherical origin, too. (auth)

42643 GAMMA RADIOACTIVITY IN FALL-OUT SAMPLES AT MILAN AFTER THE FIRST AND THE SECOND CHINESE NUCLEAR EXPLOSION. Cerrai, E.; Triulzi, C. (Laboratori CISE, Milan). Energia Nucl. (Milan), 12: 488-90(Sept. 1965).

The contribution to radioactivity of rainwater due to fallout from the two recent Chinese nuclear explosions was investigated. Gamma spectra revealed the presence at a very low level of different short-lived radionuclides such as ^{147}Nd, ^{141}Ce, ^{140}Ba–^{140}La, ^{131}I, ^{103}Ru and ^{95}Zr–^{95}Nb. (auth)

42644 RADIOCARBON. VOLUME 7. Deevey, Edward S.; Flint, Richard Foster; Rouse, Irving (eds.). Radiocarbon, 7: 1-414(1965).

Data obtained from radiocarbon methods of age estimation are summarized in 36 papers. (M.C.G.)

42645 STRONTIUM-90 DEPOSITION FROM FALLOUT IN EUROPE. Steinhauser, Ferdinand. Wetter Leben, 17: 1-13(1965). (In German).

The distribution of ^{90}Sr deposition from precipitation was determined by monthly assays of precipitation collected at nine stations in Europe, which belong to a worldwide network of fallout monitoring stations. Observations made at Vienna and Klagenfurt after the middle of 1957 and at the other stations after the end of 1959 make it possible to follow the variations of ^{90}Sr in fallout and to evaluate the total ^{90}Sr fallout levels up to the middle of 1964. From the beginning of 1954 to the end of June 1964 the ^{90}Sr fallout levels from rain water amounted to 45.6 mC/km^2 at Vienna and 61.9 mC/km^2 at Klagenfurt. More than a half of these totals were deposited after 1961. A distinct maximum of the annual variation of the ^{90}Sr deposits occurred in May. An investigation of the distribution and time variation of the ^{90}Sr specific activity per liter of rain water showed that, on an average over the seven years of observations at Vienna and Klagenfurt, this specific activity is 6 to 7 times larger in May than in November. In the second quarter of 1963 the ^{90}Sr specific activity had its absolute maximum and was more than three times larger than in the same quarter of 1959. The latitude dependency of the ^{90}Sr deposits from precipitation in 1962 and 1963, as well as the latitude dependency of the ^{90}Sr deposits in the soil obtained from soil analysis up to January 1, 1964 were determined using world wide average values for zones of 10° of latitude. The annual variation of the ^{90}Sr deposits from precipitation showed a delay in reaching a maximum, which increased with latitude from March in 20 to 30°N to August in 70 to 80°N latitude. The ^{90}Sr deposits in the soil found by the soil analysis were compared with the ^{90}Sr deposits from precipitation observed at the same stations. (BBB)

Techniques and Equipment

42646 (AAEC/E-137) THE USE OF RADIOISOTOPES AS GROUND-WATER TRACERS IN THE BURDEKIN DELTA AREA OF NORTH QUEENSLAND, AUSTRALIA. Andrew, J. T. G.; Ellis, W. R.; Seatonberry, B. W.; Wiebenga, W. A. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). May 1965. 44p. Dep. mn.

The radioisotopes iodine–131 and tritium were used to determine aquifer porosities and permeabilities in a series of pumped bore tests. If reasonable values for porosity can be assumed, the methods can also be used to estimate the thickness of an aquifer. The direction and rate of flow of natural ground water was also determined by means of a free flow test, using these isotopes. (auth)

42647 A METHOD FOR THE DETERMINATION OF AQUIFER PARAMETERS USING RADIOACTIVE ISOTOPES. Hazzaa, I. B.; Girgis, R. K.; Saad, K. F. (Middle Eastern Regional Radioisotope Centre for the Arab Countries, Cairo). Intern. J. Appl. Radiation Isotopes, 16: 487-93 (Aug. 1965).

A method for measuring the lowering of the water level in wells during pumping was developed. A γ source was arranged to float on the water surface in the piezometer well and the variation of the counting rate obtained by a G-M detector caused by the lowering of the source due to pumping from a nearby well was registered. A calibration was made to give the dependence of the counting rate on the vertical distance between the source and the detector in the piezometer. In this way a (drawdown–time) curve for a constant pumping rate could be constructed. From this curve, the aquifer parameters, coefficients of transmissibility, permeability, and storage, were obtained. This method gave an instantaneous response for the variation in the water level. It was applied on a pumped well with a 50-m distant piezometer in the Wadi El Natrun area. The results were compared with those obtained by the conventional hydrologic method. (auth)

42648 SIGNIFICANCE OF STRONTIUM ISOTOPE RATIOS IN THEORIES OF CARBONATITE GENESIS. Hayatsu, A.; York, D.; Farquhar, R. M. (Univ. of Toronto). Nature, 207: 625-6(Aug. 7, 1965).

Calcite separated from Grenville marble and from a number of calcite-silicate rocks that represent extensively metasomatized limestone was examined. Isotope ratios were normalized to ^{86}Sr/^{88}Sr = 0.1194. From the results it was concluded that if the ^{87}Sr/^{86}Sr ratios in the limestones described were not affected by the metamorphism, then there must have been a very considerable spread in the ^{87}Sr/^{86}Sr ratios in the original limestones. If the samples were assumed to have originated with some common limestone value for the ^{87}Sr/^{86}Sr ratio, then there is a significant decrease in this ratio with increase in the degree of metamorphism/metasomatism. It is not suggested that carbonatites are either limestone xenoliths or mobilized limestones but it is doubted that the studies of strontium isotopic composition prove that they are not. (P.C.H.)

42649 NEUTRON AND GAMMA-RAY DIE-AWAY IN A HETEROGENEOUS SYSTEM. Mills, W. R. Jr.; Allen, L. S.; Selig, F.; Caldwell, R. L. (Socony Mobil Oil Co., Inc., Dallas). Nucl. Appl., 1: 312-21(Aug. 1965).

The die-away of thermal neutrons and capture gamma rays from a pulsed source was measured in a heterogeneous rock-fluid system for a variety of physical conditions. The system was a cubical lattice about one meter on a side, consisting of vertical calcium carbonate rods and empty channels. The channels were filled with either calcium carbonate rods or fluid, thus giving a variable volume ratio of rock and fluid. Measurements with a ^{3}He counter and NaI detector were carried out in a 7-in. (18-cm) diameter hole through the middle of the cube. Experimentally measured neutron lifetimes were compared to values calculated from a three-group time- and space-dependent computer code. A theoretical gamma decay curve was calculated from a spatial integration over the computed neutron distribution. Unattenuated and singly scattered radiation were included. (auth)

42650 KRATKOE RUKOVODSTVO PO OPREDELENIYU PLOTNOSTI PORED I RUD METODOM OSLABLENIY GAMMA LUCHEI. (Brief Manual for Determining the Density of Rocks and Ores by the Gamma Attenuation Method). Artsybashev, V. A. Moscow, Gosgeoltekhizdat, 1963. 59p.

Rules for determining the density of rocks and ores by the method of attenuation of gamma rays in a wide beam,

using serial radiometric apparatus and widely spread out radiation sources, are presented in detail. This method for absolute density measurements does not require advance calibration of the apparatus by density standards and maintains accuracy acceptable for practical situations — statistical errors about 2 to 3% and systematic errors of 1.0 to 1.5%. (M.J.T.)

42651 GAMMA-METOD IZMERENIYA PLOTNOSTI. (Gamma Method for Determining Densities). Aptsybashev, V. A. Moscow, Atomizdat, 1965. 203p.

The theory, method, and techniques of γ method for density measurements and studies of ore deposits, rocks, soils, and road terrain are described. (R.V.J.)

Thorium and Uranium Minerals

42652 THE CHARACTERISTIC DATA OF STANDARD SAMPLES USED FOR THE ABSOLUTE CHRONOLOGY OF RADIOACTIVE MINERALS. Kovach, Adam; Samsoni, Zoltan. At. Kozlemen., 7: 29-35(Mar. 1965). (In Hungarian).

The determination of the characteristic data (U-, Th-, Pb-content, the isotopic constitution of Pb) of the samples of pitchblende and monazite, used as standards for chronological works in the Soviet Union is given. Results of measurements are included. (auth)

HEALTH AND SAFETY

See also BIOLOGY AND MEDICINE — Radiation Hazards and Protection
GEOLOGY AND MINERALOGY — Natural Radioactivity and Fallout

Refer also to abstracts 42238 and 42599.

42653 (AECL–2222) COMPUTER METHODS FOR FAMILY LINKAGE OF VITAL AND HEALTH RECORDS. Kennedy, J. M.; Newcombe, H. B.; Okazaki, E. A.; Smith, M. E. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Apr. 1965. 30p. Dep.; AECL $1.00 cy.

A computer method is described for the family linkage of data from vital statistics and health data so that records pertaining to a single individual or to members of a single family are linked to each other. The resulting data are useful for a variety of studies of medical, genetical, and demographic interest. Data were coded for the Control Data C-20 computer. The general structure of the master file and methods for the insertion of new records into the proper place within a super family, the manipulation of raw data to prepare preliminary files, and the linkage program are described. Operating experience gained from work on a sample of 60,000 records is reviewed. Auxiliary programs for scanning the master file to extract detailed or summary information are described. Rules for Soundex coding, details of coding information in the records, formats of typical input information, and weighting factors used are included. (C.H.)

42654 (BNWL–90) EVALUATION OF RADIOLOGICAL CONDITIONS IN THE VICINITY OF HANFORD FOR 1964. Wilson, R. H. (ed.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). July 1965. Contract AT(45-1)-1830. 206p. Dep. mn; CFSTI $6.00 cy, $1.25 mn.

The evaluation of results obtained from the Hanford environmental surveillance program for 1964 indicates that most of the environmental radiation exposure for the majority of persons living in the neighborhood of the Hanford project was due to natural sources and world-wide fallout rather than to Hanford operations. Of the low-level wastes that are released to the environment from the Hanford plants, neutron-induced radionuclides present in reactor cooling water discharged to the Columbia River continued to be the source of greatest potential exposure to people in the environs. The primary pathways of exposure from this source are drinking water derived from the river, consumption of fish and waterfowl which inhabit the river, and foodstuffs grown on land irrigated with water pumped from the Columbia downstream from Hanford. ^{131}Iodine in the Hanford environs remained at very low concentrations in 1964. The Chinese nuclear test on October 16 caused a brief increase in ^{131}I, but concentrations soon returned to the low levels experienced during most of 1964. The postulated maximum exposure from ^{131}I to the thyroid of a small child amounted to only about 5% of the Radiation Protection Guide recommended for individuals by the Federal Radiation Council. (C.H.)

42655 (CEX-62.11) DISTRIBUTION OF WEAPONS RADIATION IN JAPANESE RESIDENTIAL STRUCTURES. Operation BREN. Cheka, J. S.; Sanders, F. W.; Jones, T. D.; Shinpaugh, W. H. (Oak Ridge National Lab., Tenn.). Mar. 1965. 114p. Dep. mn; CFSTI $1.25 cy, $0.75 mn.

The Oak Ridge National Laboratory Health Physics Research Reactor, attached to a hoist platform on a 1500-ft tower at the Nevada Test Site, was used in a continuation of studies to evaluate radiation doses of persons exposed to nuclear weapons. As a part of the operation, distribution of radiation in radiation analogs of Japanese residences was studied. Measurements of neutron and gamma radiation were made in single houses and in group configurations. Formulas describing the radiation patterns with respect to house parameters were derived by the use of multiple regression analysis. Nine parameters were found to predict the radiation exposures at the measured points so that 50% of the predictions were in error by less than ±6% and 90% of the predictions were in error by less than ±17%. These formulae can be used to evaluate individual exposures in Hiroshima and Nagasaki. (auth)

42656 (GAT–505) ENVIRONMENTAL RADIATION LEVELS AND CONCENTRATIONS, FIRST HALF 1965. Kalmon, B. (Goodyear Atomic Corp., Piketon, Ohio). July 19, 1965. Contract AT(33-2)-1. 10p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

The average environmental radiation and concentration levels in the vicinity of the Portsmouth Area Gaseous Diffusion Plant for the first six months of the calendar year 1965 are summarized. For the first half of 1965, the average concentrations, for both alpha and beta-gamma activity in the neighboring streams, creeks, and river are above previously reported values. The over-all averages and maximum values in off-plant waters, however, are well within permissible concentrations. For alpha activities, the average and maximum concentrations were 0.19 and 2.98% of the maximum permissible concentration (MPC), and for beta-gamma activities the average and maximum concentration values were 0.49 and 18% respectively. The average airborne alpha activity also showed an increase compared with the past averages, while the beta-gamma airborne activity declined. The average airborne alpha activity was 16.1% of the maximum permissible concentration as compared to the usual 5%. In March and April, increases were noted and appeared to result from operating difficulties in a production area where uranium products had been releasing to the atmosphere during the reporting period. Two of the samples were in excess of the MPC for off-site locations. The semi-annual background exposure rates indicated a significant decrease from 47% to 30% of the maximum permissible exposure (MPE). In calculating the percentages, the activity is assumed to result from plant operations. As in the past, the on-site and off-site results are similar in trends with no appreciable difference between the two average values; therefore, it is concluded that the background counting rates are due to causes other than plant operations such as natural background and fall-out from past nuclear detonations. The over-all average concentrations and background exposure rates are tabulated on the following page along with the values for the corresponding period in 1964, the second half of 1964, and for the calendar year 1964. (auth)

42657 (NP-14922) GUTACHTERLICHE STELLUNGNAHME ZUR VERWENDUNG VON THALLIUM-204 ALS SIMULATOR FUER EINE KONTAMINATION MIT RADIOAKTIVEM FALLOUT. GENANNT: FALLOUT-DARSTELLUNGSGERAET. (Expert Opinion on the Application of ^{204}Tl as Simulator for a Contamination with Radioactive Fall-out. Called: Fall-out Simulator). Seelentag (Bundesgesundheitsamt, Berlin (West Germany). Institut fuer Wasser-, Boden- und Lufthygiene). June 19, 1964. 41p. Dep. mn.

The suitability of ^{204}Tl as a fallout simulator for training personnel in the measurement of radioactive contamination and the dangers to personnel and the environment of such usage were investigated. The fallout simulator is described, and the specific questions to be answered on its suitability are indicated. The characteristics and physical data of the model simulator are discussed. The radiation burden from ^{204}Tl was theoretically determined. The gamma spectrum, attenuation, and dose were experimentally studied. It was concluded that the simulator was suitable for training purposes if certain precautions were taken. (J.S.R.)

42658 (NP–15328) EVALUATION OF FALLOUT CONTAMINATION OF WATER SUPPLIES. Final Technical Re-

port, October 1, 1963–May 15, 1965. Grune, Werner N.; Atlas, Henry S.; Hamel, Gerard J. (Merrimack Coll., North Andover, Mass. Div. of Engineering). Contract OCD-PS-64-62. 234p.

A theoretical evaluation was conducted to determine the potential degree of water contamination from fallout and to assess the biological hazards associated with the ingestion of water following hypothetical nuclear attack. The appraisal was carried out by applying the assigned fallout model to various levels of nuclear war and by quantitative correlation of all phases of the flow of radioactive fallout in public water supplies. The water supply systems of three cities were selected for the evaluation of contamination to study the potential hazards and radiobiological effects. Maximum levels of ^{89}Sr, ^{90}Sr, ^{106}Ru, ^{131}I, ^{137}Cs, and ^{140}Ba were calculated and reported in $\mu C/ml$. Results indicate that water contamination for some cities may be at a substantial level of activity, especially when watershed runoff is included. Direct surface contamination of these reservoirs, excluding any contribution from watershed runoff, resulted in activity concentrations which were lower by a factor from 10 to 100. A detailed analysis of various criteria for biological uptake was completed. Ten computer programs were established to assist the computations in various phases of the study. A study was also made to obtain a first approximation of the relationship between activity distribution and fallout particle size. The relationship is observed to be in close conformance to a log-normal distribution. (H.G.D.)

42659 (ORNL-NSIC-9) INDEXED BIBLIOGRAPHY OF CURRENT NUCLEAR SAFETY LITERATURE—2. (Oak Ridge National Lab., Tenn.). Aug. 1965. Contract W-7405-eng-26. 203p. ORNL Free.

Bibliographic items with short abstracts and keywords are presented under 19 categories or types of nuclear safety information. Keyword and personal author indexes are included. (D.L.C.)

42660 (ORNL-TM-1209) REDISPERSION OF SURFACE DUST IN A ROOM. Royster, G. W. Jr.; Fish, B. R. (Oak Ridge National Lab., Tenn.). Aug. 2, 1965. Contract W-7405-eng-26. 19p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Redispersion of deposited particulates from surfaces in a semi-isolated environment was studied with regard to the probability of a given particle population being resuspended by the movement of persons in the area. This information is related to the spread of biological contaminants in hospitals as well as to the maintenance of low dust levels in clean rooms. Copper oxide dust with a particle size range up to 5 μ was dispersed into a room and the concentration measured at intervals during settling. The deposition was then measured and compared with the redispersion concentration in the air as affected by various conditions of room ventilation and occupancy. Surface treatments, such as oiling the floors, are seen to enhance the retention of particles on surfaces. Jets of air impinging on the floor with a velocity of 80 meters per second remove 30 per cent of the total deposition on clean, waxed, asphalt tile floors and remove none of the deposit from the same floor covered with a thin oil coating. The degree of resuspension is directly related to the level of human activity in the contaminated area. (auth)

42661 (SB-501(Suppl.1)) CIVIL DEFENSE. Selective Bibliography of Government Research Reports and Translations. (Clearinghouse for Federal Scientific and Technical Information, Springfield, Va.). Apr. 1965. 11p. CFSTI Free.

Approximately 160 references, some with indicative abstracts, are presented. (D.L.C.)

42662 (ORNL-tr-600) FREIGHT CONTAINER FOR RADIOACTIVE MATERIALS. Nachabar, Henry D.; Biggs, Billy B.; Tariero, Paul J.; George, Kurt O. Translated for Oak Ridge National Lab., Tenn., from Japanese Patent 409,289. Apr. 13, 1963. 12p. Dep. mn; JCL $1.60 fs, $0.80 mf.

A freight container is designed for transporting used reactor fuel elements. The container comprises a cylindrical pressurized chamber with a primary coolant, shielding materials, a removable revolving cover, an eccentric loading-unloading port, raising devices for the cover and container, an interior heat exchanger for removing heat from the primary coolant, inlet and exit pipes, and indicators of coolant temperature and pressure. (D.L.C.)

42663 CONTRIBUTIONS TO THE STUDY OF THE VARIATION OF β ACTIVITY OF THE VEGETATION WITH THE GATHERING PLACE. Munteanu, G. Acad. Rep. Populare Romine, Studii Cercetari Fiz., 15: 591-600(1964).

A series of measurements was made on the β-activity in certain plants gathered in several places within the region of the city of Brasov. Some of the most representative vegetation types of this area were chosen, namely: pine-needles (Picea excelsa), moss (Eurynchium genus), and grass. The radioactivity measurements were carried out by means of a counting device of the type "Cuanta" of 6,000 pulses/min, with a (MST-17) lead-screened frontal β counter. A fixed geometry was adopted. The activity of the vegetation sample was expressed by the rate of counting referred to a gram of ash (pulses/g/min). The results are presented in graphs and tables. Significant variations in the β-activity of the vegetation as a whole, with the gathering place were observed. The conclusion frequently reached according to which the β-activity of plants depends on species, was confirmed. The high activity of all the vegetation types investigated at Poiana Brasovului is emphasized and coincidences were observed concerning the aspect of the variations of the β-activity of the vegetation types gathered at various spots. (Rumanian Science Abstr. Vol. I, Oct. 1964).

42664 RADIOLOGICAL HEALTH: A GROWING CHALLENGE TO THE PUBLIC HEALTH PROFESSION. Chadwick, Donald R. (Public Health Service, Washington, D. C.). Am. J. Public Health, 55: 613-14(Apr. 1965).

The recent creation of a Radiological Health Section within the American Public Health Association (APHA) is discussed. The action by APHA in creating a Radiological Health Section provided a medium for interdisciplinary and interfield communication. Membership in the APHA affords the radiological health worker opportunities to: work with health officers, engineers in charge of environmental health programs, and educators to determine best training for health workers either primarily or tangentially responsible for radiological health; maintain liaison with the federal agencies and Congress through APHA's Washington office; and participate in national programs on radiological health directed to the multidisciplinary family that is APHA. It is suggested that practitioners of medicine, dentistry, and public health should make every feasible effort to prevent or reduce all unnecessary radiation exposures. (TCO)

42665 ACTIVITY CONCENTRATION IN SEWAGE OF THE MUNICIPALITIES OF BONN AND COLOGNE. Lindackers, K. H.; Saath, Th. (Technischer Uberwachungs-Verein Rheinland e. V., Cologne). Atomwirtschaft, 10: 322-4(July-Aug. 1965). (In German).

The monitoring carried out in August and September of 1962 in Bonn and in July, August, and September of 1963 in Cologne to determine the amount of radioactivity in sewage is reported. Sampling, sample processing, and measurement installation calibration are described. The results show that the maximum permissible concentration was reached one time in one location. All other values were significantly under the safety limits. (J.S.R.)

42666 CHARACTERISTICS OF WORKING CONDITIONS OF THE PERSONNEL HANDLING SOURCES OF IONIZED RADIATION. Damaskin, P. T. (Dnepropetrovsk Regional Sanitation and Epidemical Station, USSR). Gigiena i Sanit., No. 4, 71-3(Apr. 1965). (In Russian).

X-ray technicians, radiologists, and others handling ionizing sources received a dose varying from 15 to 80 mR/week. The surface reading for a number of ^{137}Cs and ^{60}Co sources was found to vary from 25 to 216 mR/hr,

or from 1.5 to 3.5 mR/hr at a distance of 1 m. The reading was decreased by a factor of 5 with the use of additional steel shielding 20 to 70 mm thick on the source. The surface readings of ^{90}Sr sources containing 20 to 400 mcs varied from 3 to 8 μR/sec. Sources containing ^{60}Co, ^{192}Ir, ^{137}Cs, ^{170}Tm, and $^{152-154}Eu$ are used often in radiography. Most of these sources were shielded so as to give a dose rate of 0.2 to 1 μR/sec. The yearly dose to technicians working with these sources varied from 0.04 to 0.25 R. Additional concrete shielding and the placement of shielding screens were recommended in a number of hospitals operating x-ray machines and ^{60}Co teletherapy units. The total x-ray dose to operating personnel varied from 50 to 80 mR/week for a 30-hr working week. These doses did not exceed the maximum allowable dose of 100 mR/week, but could be lowered significantly by using proper protective measures. (TTT)

42667 THE POSSIBLE CONSEQUENCES OF INFRINGEMENT OF WORK REGULATIONS IN PERFORMANCE OF X-RAY STRUCTURAL ANALYSES. Stavitskii, R. V.; Omelyanenko, L. M.; Merkova, M. A.; Karlashenko, N. I. (Central Inst. for Medical Graduate Work, Moscow). Gigiena i Sanit., No. 5, 58-62(May 1965). (In Russian).

Data suggesting infringements on work regulations in performing structural analyses with x radiation are presented. Measurements indicated that x-ray intensity at the site of the working pencil may be very high. Consequently, accidental exposure of the hands to the x-ray beam and of the face and breast to scattered radiation is possible. Radiation burns often resulted in such cases. Factors contributing to acute exposure were largely lack of work experience, qualifications for the job, or knowledge of protective devices. Medical examination of persons suffering from radiation burns on the hands revealed no signs of radiation sickness. (H.G.D.)

42668 DEACTIVATION OF SURFACES CONTAMINATED WITH THORIUM COMPOUNDS. Pavlovskaya, N. A.; Skripchenko, E. S. (Inst. of Industrial Hygiene and Occupational Diseases, Academy of Sciences, USSR; All-Union Research Inst. of Fats, Moscow). Gigiena i Sanit., No. 5, 61-6(May 1965). (In Russian).

A series of detergents were tested for effectiveness in decontaminating thorium-contaminated surfaces of polychlorovinyl linoleum, 57-40 plastics, and certain lamellar plastics. For the 57-40 plastics and the linoleum, the most effective detergent was composed of soda-contact, sodium metasilicate, and carboxymethylcellulose. Thorium activity remaining after treatment was 0.2% for the plastics and 0.8% for the linoleum. The most effective detergents for decontaminating lamellar plastics was a combination of 1% sulfonol, contact-soda, and arcvade. Thorium activity remaining after use of the solution was 2 to 4%. (H.G.D.)

42669 EVALUATION OF MARINE CONTAMINATION WITH RADIOISOTOPES OF LONG HALF-LIVES. Yamagata, N. (Inst. of Public Health, Tokyo). Health Phys., 11: 1005-8(Oct. 1965).

A concept using the average concentration factor of stable Co, Cr, Cs, Fe, Mn, and Zn from sea water to the sea food as a whole, or the equivalent daily intake of sea water, was introduced in the evaluation of marine contamination with radioisotopes of long half-lives. The factors were determined on the basis of accumulated data on the trace-element composition of typical diets in Japan. (auth)

42670 CRITERIA FOR ACUTE EXPOSURE TO MIXED FISSION PRODUCT AEROSOLS. Brodsky, Allen (Univ. of Pittsburgh). Health Phys., 11: 1017-32(Oct. 1965).

The biological effects of exposure to inhalation of mixed fission products were estimated as a function of operating time from short bursts to 3 years, and for decay times from 0 to 4 years. For comparison with previous results at given operating and decay times, the multiple acceptable emergency doses (AED) from various mixtures were calculated using an approach similar to that of Cowan and Kuper, but using re-calculated fission product inventories, more recent ICRP data, a revised set of individual emergency organ doses and different methods of estimating lung and GI tract doses. The twenty-one nuclides chosen for biological importance comprised the major part of both short-burst and reactor operation activities. The total beta activity of these twenty-one nuclides also followed the empirical decay of total fission products within about a factor of 2. The acceptable emergency exposure of gross fission product mixtures remained within a factor of 2 of 1 C-sec/m^3 for decay times of less than 30 days for all operating times and an adult breathing rate of 17 l/min. Fission product inventories and acceptable exposures are presented as functions of both operating time and decay time. (auth)

42671 NEUTRON-INDUCED RADIOPHOSPHORUS-32 IN FOOD. Wampler, Stanley N.; Ellis, Mary K.; Yager, Robert H. (Walter Reed Army Medical Center, Washington, D. C.). Health Phys., 11: 1043-6(Oct. 1965).

Food samples were examined for radioinduced phosphorus-32 after exposure in a nuclear reactor to a thermal neutron flux range of 10^9 to 10^{14} n cm^{-2} sec^{-1}. The activities induced closely approximated the activities expected from calculations using a standard activation equation. The use of a nuclear reactor to simulate thermal neutron flux of weapons proved feasible. (auth)

42672 VULCANIZED LATEX AS AN AID FOR CLEARING AWAY RADIOACTIVE CONTAMINATIONS. Venis, C. G. (Philips Gloeilampenfabrieken N. V., Eidhoven, Netherlands). Health Phys., 11: 1091-2(Oct. 1965).

A method is described for removal of radioactive contaminations by means of vulcanized latex. Vulcanized latex is a milk-white liquid, consisting of rubber particles suspended in water with a small content of ammonia. Usually the rubber content is approximately 60 per cent (by weight and by volume). When a quantity of that latex is spread on a floor and the water evaporates, there remains a strong and very extensible film of rubber which, in most cases, can be removed very easily. As the latex encloses all loose particles that lie on the floor, the particles are embedded in the rubber film. For removal of radioactive contaminations, the method is interesting because the volume of rubber film in which the contaminating material of a given area of floor or table-top is gathered, is so small. A film of about 0.15 mm thickness is strong enough to be removed from most surfaces without difficulties; 1 m^2 of such a film has a volume of only 0.15 dm^3. A further advantage is that the work can be done in a very short time. (C.H.)

42673 TIME VARIATION OF THE DOSE-RATE FROM RADIOACTIVITY INDUCED IN HIGH-ENERGY PARTICLE ACCELERATORS. Sullivan, A. H.; Overton, T. R. (CERN, Geneva). Health Phys., 11: 1101-5(Oct. 1965).

The radiation dose-rate due to radioactivity induced in high-energy particle accelerators complicates the maintenance of such machines and it will become a major consideration, both in the design of new machines and in projects for raising beam intensities in present machines. The dose likely to be received by a person engaged in accelerator maintenance depends on many factors, and the problem of calculating this dose from machine parameters would be very complicated thus making the result uncertain. One method of estimating the probable dose-rates near future accelerators is to extrapolate from the measured dose-rates near existing machines. To make this extrapolation, a knowledge is required of the time variation of these dose-rates. It is therefore important that the general laws of build-up and decay of the induced radioactivity (and its associated dose-rate) be established. The radioactivity induced in a high-energy particle accelerator comprises a complicated mixture of radio-isotopes each building up and decaying with its characteristic half-life. Dose-rate measurements made at 100 different positions 24 hr after machine stop of the CERN PS machine are compared with predictions made from theory. (C.H.)

42674 CORRELATING SOILING INDEX WITH BETA ACTIVITY. Shaw, George E. (Nevada State Health Dept., Reno); Ledbetter, Joe O. Ind. Med. Surg., 34: 638-9 (Aug. 1965).

Studies were made to determine the feasibility of using the soiling index to calculate the radioactivity in the air during periods of no short-term fallout from atomic tests. The experiments were made in Austin, Texas. The soiling index of the atmosphere is measured by the amount of attenuation the sampled matter offers to light transmittance. While the mathematical correlation of soiling index and beta radioactivity was not very high, it is believed that a satisfactory measure of beta activity could be obtained by this method, especially with some modifications in the equipment and procedure. (P.C.H.)

42675 PROTECTION AGAINST NUCLEAR WEAPON FALLOUT IN EMERGENCY HEALTH SERVICES UNITS. Page, F. C. (Dept. of National Health and Welfare, Ottawa). Med. Serv. J. (Can.), 21: 95-112(Feb. 1965).

Health hazards of fallout, management of a health unit, and early effects of various radiation doses are discussed in detail. The protective value of various shelter types, dose rates received, and use of dosimeters are described. A forthcoming manual is announced. (H.G.D.)

42676 THE CONTAMINATION AND THE ACCUMULATION OF RADIUM AND RADIOSTRONTIUM IN THE SWISS WATCH INDUSTRY. Wenger, P.; Soucas, K. (Service Cantonal de Controle des Irradiations, Geneva). Radiol. Clin. Biol., 34: 67-71(1965). (In French).

Results are reported of whole-body counting of workers with luminous paints in the watch industry. Radium contamination was measured with the whole-body counter (106 cases), and radon content was measured in the expirated air. The majority showed values of 0.10 to 10 times the tolerance dose (0.1μg), and 37 times or between 0.1– > 1.0 μg Ra. In home workers the percentage of contamination was lower than in factory workers. Forty-six workers with ^{90}Sr were examined: the urine excretion allowed a conclusion of the whole-body dose: 10^{-4} μC ^{90}Sr daily dose in urine yielded 0.2 μC body dose, which corresponds to 0.10 tolerance dose. In 10 cases, a ^{90}Sr contamination of 0.10 to 1 tolerance dose was found. (tr-auth)

42677 RADIOLOGICAL HEALTH DATA [MONTHLY REPORT], VOLUME 6, NUMBER 6. (Public Health Service, Washington; D. C.). June 1965. 42p. GPO, $0.50 cy.

Data are presented on: air and fallout; radionuclide contamination of milk, food, and water; environmental radioactivity; and nuclear detonations during May 1965. Gross beta activity in airborne particulates and precipitation is reported by the radiation surveillance network of the Public Health Service and by air monitoring programs in Canada, Mexico, the Pan American countries, and North America. Strontium-90, ^{137}Cs, and ^{131}I levels in milk were determined by the Pasteurized Milk Network of the Public Health Service and milk networks in California, Oregon, Pennsylvania, Texas, Canada, and Pan American countries. Calcium–strontium-90 ratios were analyzed by the Health and Safety Laboratories of the USAEC in liquid and powdered milk and in powdered buttermilk. Samplings were made of the average per person dietary consumption and ^{90}Sr intake in New York City, Chicago, and San Francisco and of the ^{90}Sr content of tap water in New York City. Measurements of gross radioactivity in surface waters of the United States during December 1964 are tabulated and discussed. Environmental levels of radioactivity at Brookhaven National Laboratory and at the Rocky Flats Plant of the Dow Chemical Company are presented for the period from July to December 1964. Nuclear tests reported during May 1965 include four announced by the AEC and one test on the Chinese mainland reported by the State Department. (H.G.D.)

INSTRUMENTATION

General

Refer also to abstracts 42964, and 43502–43503.

42678 (AD-609658) EFFECT OF MAGNETIC FIELDS ON MICROWAVE GAS-DISCHARGE DUPLEXER CHARACTERISTICS. True, Robert M.; Edwards, Edward V. (Army Electronics Lab., Fort Monmouth, N. J.). Sept. 1964. 49p. (ECOM-2516). CFSTI $2.00 cy, $0.50 mn.

An experimental investigation was made to determine some of the effects of a confining magnetic field on a gaseous plasma within a duplexing device. Both the parallel and crossed E and H field configurations were examined using a helium and a helium-neon Penning mixture gas fill. Temperature measurements indicated that magnetic confinement could lower the r-f window temperature of a gaseous discharge duplexing device by more than 50% at pressures below 0.5 torr. Leakage power was also reduced by 50% or more in this pressure range, but the leakage level in the parallel field device is inherently too high for practical application. Reductions up to 4.5-to-1 were obtained in the recovery time of helium in the 2 to 50 torr pressure range using a crossed-field configuration. By magnetically confining the plasma discharge of a gaseous duplexer, the performance can be significantly improved by lowering temperatures and gas clean-up rates. (auth)

42679 (JINR-P-2160) MAGNITNYI SPEKTROMETR S VARIATSIEI POLYA. (A Magnetic Spectrometer with Field Variation). Tarantin, N. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1965. 13p. Dep. mn.

A magnetic spectrometer with field variation along the particle trajectories is described. The field variation is produced by means of flat shims and cuts in the flat pole tips of the magnet. The field variation promotes an increase of the dispersion properties of the homogeneous field. The spectrometer with the field variation provides also the axial focusing of the beam. (auth)

42680 (JINR-P-2274) OSOBENNOSTI POVEDENIYA GIBRIDNYKH VOLN V KRUGPOM VOPNOVODE, CHASTICHNO ZAPOLENNOM ANIZOTROPNYM DIELEKTRIKOM. (Peculiarities of Behavior of Hybrid Waves in a Circular Waveguide Partially Filled With an Anisotropic Dielectric). Vagin, V. A.; Kotov, V. I.; Ofitserov, M. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1965. 12p. Dep. mn.

The behavior of hybrid waves in a circular waveguide partially filled with anisotropic dielectric medium which is characterized by a diagonal singly degenerate tensor is treated. A dispersion relation was obtained and its analysis is given. The existence of two classes of hybrid waves is shown and their properties are investigated when the tensor components are changed. One of the cases was considered when the cutoff frequencies of two hybrid modes coincide. The existence of inverse waves was proven. The results of the calculation are illustrated by the graphs. (auth)

42681 (LNF-65/9) STABILIZZAZIONE DELLA CORRENTE IN SISTEMI DI POTENZA A TRANSISTORI. (Stabilization of the Current in Transistorized Power System). Note No. 277. Avaltroni, M.; Coli, M. (Laboratori Nazionali di Frascati, Comitato Nazionale per l'Energia Nucleare (Italy)). Mar. 23, 1965. 14p. Dep. mn.

The stability of the power supply was studied as a function of the parameters of the transistorized control bank and of the counteraction coil. An analysis is given of two possible control circuits in series to the feed load. Some of the results of measurements made on a prototype are reported. (J.S.R.)

42682 (ORNL-3782) INSTRUMENTATION AND CONTROLS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 1, 1964. (Oak Ridge National Lab., Tenn.). Aug. 1965. Contract W-7405-eng-26. 172p. Dep. mn; CFSTI, $5.00 cy, $1.00 mn.

Progress is reported in sections on nanosecond circuitry and techniques, pulse counting and analysis, electrometers and accessories, miscellaneous electronics developments, instrumentation for automatic control of research equipment, instrumentation for biomedical research, detectors of ionizing particles and radiation, radiation monitors and components, radiation monitoring systems, data collection and analysis, process and controls systems engineering, process instrumentation development, reactor instrumentation and controls analysis, reactor instrumentation and controls development, instrumentation for reactor operation, and support for the high-voltage accelerator program. Separate abstracts were prepared for each section. (J.R.D.)

For abstracts of individual sections see: 42683–42691, 42714–42717, 42964, and 43502–43503.

42683 (ORNL-3782, pp 1-10) NANOSECOND CIRCUITRY AND TECHNIQUES. (Oak Ridge National Lab., Tenn.).

Performance of modular nanosecond circuitry employing tunnel diodes is described. The design and performance of sensitive Ge tunnel diodes, nanosecond circuitry, nanosecond light sources, and capacitors for nanosecond circuits are also described. (J.R.D.)

42684 (ORNL-3782, pp 20-3) ELECTROMETERS AND ACCESSORIES. (Oak Ridge National Lab., Tenn.).

Information is presented concerning development of solid-state electrometers and electrometer accessories. Design of a parallel-plate ionization chamber with an internal ^{241}Am alpha source for calibration electrometers and current integrators is described. (J.R.D.)

42685 (ORNL-3782, pp 24-8) MISCELLANEOUS ELECTRONICS DEVELOPMENTS. (Oak Ridge National Lab., Tenn.).

Standards for instrument module packaging and nuclear instrument design are discussed. Discussions are also included concerning stable power supplies for x-ray spectrometers and development of d-c power amplifiers to drive fractional-hp servo motors. (J.R.D.)

42686 (ORNL-3782, pp 29-30) INSTRUMENTATION FOR AUTOMATIC CONTROL OF RESEARCH EQUIPMENT. (Oak Ridge National Lab., Tenn.).

Design and operation of a programmed control-system for relative-position neutron diffractometers are described along with systems to measure and control specimen exposures in cyclotron beams. Design and installation of systems to control neutron exposures and temperatures of ORR in-pile specimens are also described. (J.R.D.)

42687 (ORNL-3782, pp 31-4) INSTRUMENTATION FOR BIOMEDICAL RESEARCH. (Oak Ridge National Lab., Tenn.).

Design and performance of a phosphoroscope for measurement of green plant light emission after illumination are described. Development and testing of counters to determine Neurospora Colony population densities are discussed. (J.R.D.)

42688 (ORNL-3782, pp 74-83) DATA COLLECTION AND ANALYSIS. (Oak Ridge National Lab., Tenn.).

Techniques for reducing errors and noise effects in machine-logged data are described. Analysis of control-rod drive test data by data-smoothing techniques is reported. Information is also included on application of data-logging systems, molten salt reactor data collection and analysis, automatic film-badge reader and card-punch system, smoothed thermocouple tables, and machine work order handling. (J.R.D.)

42689 (ORNL-3782, pp 84-90) PROCESS INSTRUMENTATION AND CONTROLS SYSTEMS ENGINEERING. (Oak Ridge National Lab., Tenn.).

Instrumentation and cell ventilation for the transuranium processing plant are discussed along with instrumentation for thorium-uranium fuel cycle development facility, instrumentation of the radiochemical processing pilot plant, and instrumentation of a waste evaporator. Instrumentation for measurement of liquid level in waste solution storage tanks is described along with instrumentation of reaction vessels for processing carbon-coated fuels and salt-field instrumentation for waste disposal. (J.R.D.)

42690 (ORNL-3782, pp 91-101) PROCESS INSTRUMENTATION DEVELOPMENT. (Oak Ridge National Lab., Tenn.).

Tests of infrared films for analysis of temperature distributions are discussed along with developmental work on pneumatic temperature measuring systems. Design and performance of instrumentation for studies of electric conductivity and ion diffusion in BeO are discussed. Results of Re-W thermocouple tests at high temperatures are presented. Development of low-velocity air meters is reported along with improved nephelometers and in-line fluidization detectors. (J.R.D.)

42691 (ORNL-3782, pp 140-3) INSTRUMENTATION FOR REACTOR OPERATION. (Oak Ridge National Lab., Tenn.).

Information is presented on the status of MSRE instrument development, instrument development for operating research reactors, and time measurement on sample transfer by pneumatic rabbits. (J.R.D.)

42692 SCATTERING PHENOMENA IN DOUBLE DIRECTION FOCUSING ELECTROMAGNETIC MASS SEPARATORS. Menat, M. (Israel Atomic Energy Commission, Tel Aviv); Frieder, G. Can. J. Phys., 43: 1525-42 (Aug. 1965).

A series of experiments has shown that both elastic scattering and charge-exchange scattering of a directed ion beam by residual gas are dominant factors causing contamination in electromagnetic mass separators. These phenomena are treated numerically for various double-direction focusing machines. The method is based on geometrical considerations and on an appropriate and reliable interaction potential between the ions and the residual gas molecules. Significant expressions for the fractional contaminations as caused by these scattering phenomena are derived. The values depend on such factors as the residual gas molecule concentration, the fractional mass difference, the collector hole area, the magnet radius, a configuration factor, and some constants which appear in the expressions for the differential cross sections. By performing the various integrations in a different sequence, general expressions for the transmission from source to collector are obtained. (auth)

42693 X-RAY AMPLIFIER FOIL AND LIGHT SCREEN PROPERTIES AND THEIR MEASUREMENT. SUGGESTIONS FOR STANDARDIZATION. Angerstein, W. (Forschungsinstitut fuer Tuberkulose and Lungenkrankheiten, Berlin). Radiol. Diagn., 5: 367-72(1964). (in German).

The information which is needed by users of x-ray foils and light screens to obtain the greatest benefit from these products and which should be supplied by the manufacturers is outlined, together with tests for deriving the information when it is not provided. Standardization of manufacturing tolerances for such equipment is also advocated. (D.C.W.)

42694 MAGNETIC DOUBLE RESONANCE SPECTROMETER FOR DYNAMIC NUCLEAR POLARIZATION AND RELAXATION TIME MEASUREMENTS AT 175 G. Gruetzediek, H.; Kramer, K. D.; Mueller-Warmuth, W. (Max-Planck-Institut fuer Chemie, Mainz). Rev. Sci. Instr., 36: 1418-22(Oct. 1965).

A magnetic nuclear-electron double resonance spectrometer operating in magnetic fields of about 175 gauss is described. It is suited for measurements of dynamic nuclear polarization and relaxation times in proton and fluorine containing solvents. The NMR spectrometer is a Q-meter device synchronized by a crystal oscillator. The u-h-f setup for the saturation of the ESR lines consists of a frequency multiplied driver stage and a 493-Mc power stage. The sample is placed inside a quarter wavelength coaxial cavity with the NMR coil around it. A rapid modulation technique allows u-mode detection and convenient comparison of NMR signals with and without ESR irradiation. The nuclear relaxation times (T_2) are measured by observing the decay of the magnetization brought into the x,y plane by an adiabatic passage in the presence of a strong rf field. The performance is demonstrated with examples of proton polarization studies in organic solutions of free radicals. (auth)

42695 MEANS OF REDUCING RINGING TIMES IN PULSED NUCLEAR MAGNETIC RESONANCE. Spokas, John J. (Argonne National Lab., Ill.). Rev. Sci. Instr., 36: 1436-9(Oct. 1965).

Two auxiliary circuits are described for incorporation in a pulsed nuclear magnetic resonance system to reduce the deadtime of the system following an r-f exciting pulse. The function of one, a driven balanced clamp, is to reduce the Q of the detecting circuit for a controlled time after each pulse. The other, a symmetric damping circuit requiring little operating power, works in conjunction with the transmitter to "square-up" the r-f pulses generated. The circuits presented here represent certain improvements in established techniques of clamping and damping. Additionally, it is pointed out that there is a particular advantage, with respect to minimizing the deadtime in a coherent system, of using timing pulses which are phase locked to the r-f reference. (auth)

42696 SENSITIVE DETECTOR FOR METASTABLE He^+ (2S) IONS. Harrison, M. F. A.; Dance, D. F.; Dolder, K. T.; Smith, A. C. H. (United Kingdom Atomic Energy Authority, Abingdon, Berks, Eng.). Rev. Sci. Instr., 36: 1443-7(Oct. 1965).

Singly charged helium ions excited to the $2^2S_{\frac{1}{2}}$ metastable state were detected by counting the 40.8-ev photons emitted when the ions were quenched in a static electric field. High sensitivity was achieved by using a photomultiplier whose photocathode almost completely surrounded the quenching field. The efficiency of the detecting system was estimated to be $8.3 \pm 2.6\ 10^{-3}$, and the sensitivity was adequate to measure a total flux of 10^3 He^+(2S) ions/sec present in a 1 μA beam of 5-kev ground state He^+ ions. The lifetime, τ(sec), of the $2^2S_{\frac{1}{2}}$ state of He^+ was measured as a function of quenching field, U(v/cm), and was found to be $1.4 \pm 0.2\ 10^{-2}/U^2$. (auth)

42697 MINIMUM-NOISE PULSE SHAPING WITH NEW DOUBLE DELAY-LINE FILTERS IN NUCLEAR PULSE AMPLIFIERS. Blalock, T. V. (Oak Ridge National Lab., Tenn.). Rev. Sci. Instr., 36: 1448-56(Oct. 1965). (ORNL-P-1277).

Three new double delay-line filters for pulse amplifiers were developed to circumvent the poor noise performance of conventional double delay-line filters. The operating principle of the new filters is the alteration of the noise spectrum stored in the delay lines prior to the signal arrival. With one of the new filters, a symmetrical bipolar output pulse was obtained that had a measured noise linewidth of 1.6 kev fwhm Si (189 rms electrons) for 5 pF external capacitance, 4.2-μsec delay-line length, and 1.4-μsec RC integrating time-constant. The noise linewidth slope was 0.05 kev/pF. (auth)

42698 LOW IMPEDANCE SOLID STATE NANOAMMETER. Otte, Victor A.; Sullivan, Russell P. (Ohio State Univ., Columbus). Rev. Sci. Instr., 36: 1504(Oct. 1965).

A low-input-impedance circuit for use in the measurement of low beam currents is described in which a commercial solid-state operational amplifier is used. (D.C.W.)

42699 HIGH RESOLUTION NMR PROBE SUITABLE FOR USE IN A SUPERCONDUCTING SOLENOID. Meiboom, S.; Hewitt, R. C. (Bell Telephone Labs., Inc., Murray Hill, N. J.). Rev. Sci. Instr., 36: 1509-10(Oct. 1965).

A tuned r-f probe that is suitable for use in a superconducting solenoid is described. With the probe operating at

a frequency of 132 Mc, a revolution of about 1 cps has been obtained with a spinning proton sample. (D.C.W.)

42700 FLUORESCENT SCREENS FOR OBSERVATION OF HEAVY ION BEAMS. Hall, D. A. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Rev. Sci. Instr., 36: 1512-13(Oct. 1965).

A fluorescent screen consisting of a thin layer of KBr on an Al back plate was found to have superior characteristics for the observation of heavy ion beams. The screen was prepared by spraying a saturated solution of KBr in H_2O onto a previously heated Al plate. (D.C.W.)

42701 LABORATORY CALIBRATION OF THE NEUTRON MOISTURE METER. Marais, P. G.; Smit, W. B. de V. (Western Province Fruit Research Inst., Stellenbosch, S. Africa). S. African J. Agr. Sci., 3: 581-601 (Dec. 1960).

By experiments with various types of soil materials, it was shown that the position of the Ra–Be source relative to the BF_3 counter has a pronounced influence on the sensitivity of the neutron moisture meter and the form of the calibration curve. Maximum sensitivity was obtained by placing the source adjacent to the counter and opposite the center of its sensitive volume. Following this procedure and using a cylindrical calibration drum measuring 61 × 61 cm and an access tube with dia 5.1 cm, linear calibration curves were obtained for all the materials employed. The use either of smaller drums or of an access tube with a greater dia resulted in curvilinear curves and in decreased sensitivity. However, surrounding the smaller drum by a cast iron neutron reflector increased the counting rate by a factor of six. The volume sampled by the neutron moisture meter is roughly a sphere, and the radius of this sphere increased from 10 cm at 100% moisture to more than 24 cm at moisture contents below 4%. End placement of the neutron source relative to the proportional counter, as opposed to center placement, increased the extent of vertical sampling in water from 20 to 23 cm, but reduced the counting rate by 30%. The calibration curves obtained with peat moss and sugar/sand mixtures differed not only from each other but also from the curves obtained with the soils. Three soils could be grouped together, but their pooled calibration curve differed markedly from the pooled curve for two other soils. A sixth soil and sand also gave different calibration curves and it is apparent that no one curve would be suitable for different materials. The relative counting rates of two neutron moisture meters were compared and found to be independent of the moisture content of the sample. The calibration curve for the second meter may therefore be computed from that of the first meter by determining their counting rates in an infinite water moderator. (BBB)

42702 SOURCE OF POLARIZED PROTONS AND DEUTERONS. PART I. DESCRIPTION OF THE SOURCE. Fleischmann, R.; Fritsch, G.; Graw, G. (Universitaet, Erlangen, Ger.). Z. Physik, 186: 468-84(1965). (In German).

The development of the Erlangen source for polarized protons and deuterons is described. Strong magnetic fields with quadrupole and sextupole symmetry for separation of spin states of atomic beams were investigated. Quadrupoles give better separation (higher polarization), sextupoles give higher total beam flux. In a first arrangement of the apparatus with quadrupole magnets, a polarized proton current of 5×10^{-9} amp at the exit of the weak field ionizer was achieved. The polarization degree was estimated by indirect methods to be more than 45%. In a second arrangement with a sextupole magnet, the polarized ion current (deuterons) at the ionizer exit was about 10×10^{-8} amp, and at the target area (3 cm^2) about 2.5×10^{-8} amp. The alignment $P_{33} = -0.27$ was measured for deuterons (110 kev) by the neutron asymmetry A in the $^3H(d,n)^4He$ reaction. (auth)

42703 SOURCE OF POLARIZED PROTONS AND DEUTERONS. PART II. MEASUREMENT OF DEUTERON POLARIZATION FROM THE d(t,n)α-REACTION. Fleischmann, R.; Fritsch, G.; Graw, G. (Universitaet, Erlangen, Ger.). Z. Physik, 186: 485-97(1965). (In German).

The source of polarized protons and deuterons, described in part I, was tested. The deuteron-alignment P_{33} was measured by the anisotropic distribution of neutrons in the $^3H(d,n)^4He$ reaction. The dependence of P_{33} on source parameters: hydrogen discharge pressure, dissociation degree of hydrogen discharge, field strength of magnetic sextupole field, and guiding field at the ionizer was investigated. The measured alignment is in good agreement with the alignment predicted by the source parameters. This justifies the calculation of the polarization degree of protons produced by this source. (auth)

42704 PENETRATIVE RADIATION REFLECTIVITY COMPARISON GAUGE. Alexander, Frank M.; Holben, Bernard C. (to Industrial Nucleonics Corp.). Canadian Patent 709,492. May 11, 1965.

A standardization method for a radiation reflectivity gauge is described. The standardization plate is incorporated in the protective shutter which covers the source and the detector, thereby eliminating the necessity of removing the measured material or turning the gauge toward an external plate to obtain a zero reading. Faster, more accurate standardization and simpler equipment are among the advantages. (F.S.A.)

42705 DOUBLE DEFLECTION SYSTEM FOR FOCUSING IONS OF SELECTED MASS AND CHARGE AT A PREDETERMINED POINT. Ewald, Heinz; Neumann, Siegfried. U. S. Patent 3,194,961. July 13, 1965. Priority date Feb. 28, 1962, Germany.

A focusing parabola spectrograph is designed to focus the ion beam entering through a single diaphragm aperture so that the width of the parabola is approximately of the same size as the diameter of the aperture. Beginning at the ion source a pair of pole shoes define a magnetic field, preferably a homogeneous one so as to curve the travel path of the ion ray. The two shoes have and define an entrance plane and an exit plane, orientated parallel to the axis of path-curvature, and being inclined to each other. The inclination preferably is an adjustable one. A plane of symmetry defined between the two pole shoes is oriented transversely to the axis of curvature of the ion beam travel path. Next to the pair of pole shoes is a pair of electrode plates either of cylindrical or toroidal shape. The plates set up an electrostatic field, and they have a curvature so that the center of the deflected ion beam travels along a medium equipotential surface set up between the plates. The plane defined by this curved center ray is parallel to the electric field but is transverse to the plane of symmetry of the pole shoes. (B.L.M.)

Radiation Detection

Refer also to abstracts 43027, 43038, 43311, 43392, 43415, 43524–43525, and 43566.

42706 (AERE-M-1602) SEMICONDUCTOR DETECTORS FOR γ-RAY SPECTROSCOPY. Gibbons, P. E.; Owen, R. B. (Atomic Energy Research Establishment, Harwell (England)). July 1965. 14p. Dep.; BIS $0.60; HMSO 3s.

The use of semiconductor detectors in the field of charged particle spectroscopy is discussed. The performance of silicon and germanium semiconductors for gamma-ray spectroscopy is discussed. The construction of the germanium detector and prospects for high atomic number semiconductors are included. (M.O.W.)

42707 (AERE-R-4866) A COMPARISON OF ^{240}Pu AND ^{109}Ag AS EPITHERMAL INDEX MONITORS FOR LONG IRRADIATIONS. Cabell, M. J.; Wilkins, M. (Atomic Energy Research Establishment, Harwell (England)). Apr. 1965. 32p. Dep.; BIS $0.90; HMSO 4s. 6d.

The use of silver monitors to measure Wescott's epithermal index parameter, $r\sqrt{T/T_0}$, during long irradiations in high neutron fluxes is described, and the mathematical expressions necessary are given. The performance of silver and ^{240}Pu monitors are compared in irradiations of two months duration and an integrated neutron flux of up

to 5.6×10^{20} neutrons per cm^2. Results using the two monitors are in agreement within the limits of error (about ±12 per cent in each case). Nevertheless silver monitors are to be preferred, not only because they are much simpler to use, but also because they need relatively little development to be made capable of yielding still more precise results. (auth)

42708 (AERE-R-4949) THE MOST ACTIVE ZONE ENCODER FOR MULTIPARAMETER ANALYSIS. Best, G. C.; Hickman, S. A.; Hooton, I. N.; Prior, G. M. (Atomic Energy Research Establishment, Harwell (England)). June 1965. 19p. Dep.; BIS $0.60; HMSO 3s.

The advantages of associative analysis for multiparameter and similar complex data are discussed. The difficulties are indicated, and an account given of how these are overcome in the design of the Most Active Zone Encoder, which forms the basis of a fully associative analyzer. (auth)

42709 (AERE-R-4961) A METHOD OF GAIN SWEEPING FOR SINGLE CHANNEL PULSE-AMPLITUDE ANALYSIS. Williams, D. (Atomic Energy Research Establishment, Harwell (England)). June 1965. 8p. Dep.; BIS $0.30; HMSO 1s. 9d.

Problems associated with various methods of gain sweeping are discussed. An improved method, employing exponential-time sweeping, is proposed and the performance of an experimental instrument described. (auth)

42710 (JINR-P-2223) OBRABOTKA DANNYKH POLUCHENNYKH PRI POMOSHCHI POLUAVTOMATICHESKOGO PRIBORA DLYA PROSMOTRA SNIMKOV S ISKROVYKH KAMER. (Processing of Data Obtained with a Semi-Automatic Device for Scanning of Spark Chamber Photographs). Bystritskii, I.; Legar, F.; Libl, P.; Maly, M.; Sgon, O.; Frish, I. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1965. 14p. Dep. mn.

A method for processing the information obtained in track measurements on a semi-automatic device PIP-35 is treated. The preparation of the numerical material for further processing is described. (auth)

42711 (JINR-P-2262) PRIMENENIE POLUPROVODNIKOVYKH ISTOCHNIKOV SVETA IZ ARSENIDA GALLIYA DLYA KALIBROVKI SISTEM, ISPOL'ZUYUSHCHIKH POLUPROVODNIKOVYE DETEKTORY YADERNYKH IZLUCHENII. (Application of Semiconductor Gallium Arsenide Light Sources for Calibrating Systems Using Semiconductor Nuclear Radiation Detectors). Naumov, V. V.; Omel'yanenko, M. N.; Rykalin, V. I.; Titova, V. F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1965. 14p. Dep. mn.

The calibration of a telescope having four layers of silicon nuclear radiation detectors is described. The telescope is calibrated by means of gallium arsenide light source. The characteristics of the gallium arsenide light sources are given. The results of investigations of the silicon detector characteristics are presented. (auth)

42712 (JINR-P-2276) METOD USILENIYA IZOBRAZHENII SLABYKH LINII KONVERSIONNYKH ELEKTRONOV, POLUCHENNYKH PRI POMOSHCHI β-SPEKTROGRAFA. (A Method for Magnifying the Images of Weak Conversion Electron Lines Obtained by Means of a β-Spectrograph). Gromov, K. Ya.; Mukhtasimov, F. N.; Umarov, G. Ya. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1965. 5p. Dep. mn.

A method is suggested for magnifying the images of the weak conversion electron lines obtained by use of a β-spectrograph. This method allows to magnify the images of the lines in the conversion electron spectra as much as 15 times. This is equivalent to an increase of the spectrograph illumination more than 15 times. There are reasons to suppose that after some modification of the technique it is possible to obtain a greater magnification coefficient. (auth)

42713 (NASA-TN-D-2917) THE DETERMINATION OF ABSOLUTE PHOTON FLUXES AND APPLICATIONS TO LABORATORY CALIBRATION PROCEDURES IN THE 100 to 300A RANGE. Tomboulian, D. H. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Aug. 1965. 11p. CFSTI $1.00 cy, $0.50 mn.

The problems and methods of making absolute measurements of the intensity of photon fluxes in the wavelength region from 100 to 300 angstroms are discussed. It is shown that a modified Geiger-Mueller counter can provide a solution to this problem. The actual application of such a Geiger-Mueller counter to the determination of the absolute photosensitivity of a specially developed open-window photomultiplier tube and of two different photographic emulsions is described. The experimental photosensitivities determined by these calibrations are also given. (auth)

42714 (ORNL-3782, pp 11-19) PULSE COUNTING AND ANALYSIS. (Oak Ridge National Lab., Tenn.).

Charge-sensitive preamplifiers with field-effect input stages are described along with low-noise vacuum-tube pulse amplifiers for semiconductor detector spectroscopy and bipolar-transistor preamplifiers for scintillation spectrometers. Design of differential count-rate meters is also described along with development of linear count-rate meter modules, pulse amplifier and count-rate meter modules, linear gates for positive 100-v pulses, and variable-time slow-coincidence units. (J.R.D.)

42715 (ORNL-3782, pp 35-51) DETECTORS OF IONIZING PARTICLES AND RADIATION. (Oak Ridge National Lab., Tenn.).

Information is presented on design of Ge semiconductor detectors for gamma spectrometry, scintillation alpha detectors, and burst fuel element detectors. Problems of radiation detection in light-water research reactors are discussed along with design parameters for fast-neutron fission scintillation detectors and calibration of radiation monitors for process water. Development work on fission chambers is reported. (J.R.D.)

42716 (ORNL-3782, pp 52-64) RADIATION MONITORS AND COMPONENTS. (Oak Ridge National Lab., Tenn.).

Development and operation of linear-logarithmic radiation monitors, gamma background monitors for remote locations, alpha-beta-gamma counters for medical use, alpha monitors for stack effluents, alpha counters for chemical process streams, and Rh-activation personal neutron monitors are described. Development of instrumentation for radiation safety and Clinch River studies is reported. Design of low-intensity radiation sources is described, and development of radiation shielding is reported. (J.R.D.)

42717 (ORNL-3782, pp 65-75) RADIATION MONITORING SYSTEMS. (Oak Ridge National Lab., Tenn.).

Discussions are presented concerning modernization and expansion of ORNL radiation monitoring and control systems, maintenance and service activities, and development of methods for telemetering data, stack monitoring, and local air monitoring. (J.R.D.)

42718 (SGAE-PH-21/1965) INSTRUMENTAL DISTORTION OF BETA SPECTRA MEASURED IN AN INTERMEDIATE-IMAGE SPECTROMETER. Paul, Helmut (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Physik-Institut). [1965]. 38p. Dep. mn.

The distortions of continuous spectra that can occur in a real spectrometer are discussed. Properties and adjustment of an intermediate-image spectrometer are discussed, and the magnification is shown to be roughly unity. Corrections for source thickness, for backscattering from the source backing and from the scintillation detector, for source-independent background, and for source-dependent gamma and electron background are discussed. Methods for checking the magnetic field and for detecting scattering in the spectrometer are considered. Upper limits are given for possible distortions due to magnetic field defects, to insufficient vacuum and to scattering from baffles. The anisotropy of a thick source due to multiple scattering is calculated in an approximate way. The resolution correc-

tion factor derived previously is presented in a more convenient form and compared with experiment. (auth)

42719 (TID–22087) A STUDY OF RADIATION INDUCED CHARGES IN LUCITE (thesis). Barnes, James Edward (Kansas Univ., Lawrence). [1964]. Contract AT-40-1-GEN-33. 54p. Dep. mn; CFSTI $3.00 cy, $0.50 mn.

A dosimeter similar to the Compton dosimeter but without lateral insulators was investigated. The dosimeter was found to not build up a potential during irradiation because of neutralization by air ions, but heating at 90°C produced a maximal potential in about 8 minutes. The same effect is observed at room temperature during a period of 6 to 8 hours. The maximum potential was found to have a linear relation to dose. The buildup of potential during heating is attributed to a combination of effects: increased conductance due to irradiation and heating, space charge relaxation in a temperature gradient, and air ion collection at each electrode. The dosimeter was found to be subject to damage by radiation, one form of which is apparently a "radiation memory" of conductivity. It was found that after irradiation the dosimeter could be successfully stored at low temperatures before measurement. Several advantages and disadvantages are given. The lucite-lead dosimeter is still in need of extensive study before it can be of much practical value. It has been suggested that some type of additive or pre-treatment might eliminate some of the damage by radiation. The use of another dielectric material as the insulator-scatterer might also eliminate some of the problems found. (auth)

42720 (UCRL–16190) LITHIUM-DRIFTED SILICON RADIATION DETECTOR PRODUCTION PROCESS. Lothrop, Robert P.; Smith, Harry E. (Lawrence Radiation Lab., Univ. of California, Berkeley). June 11, 1965. Contract W-7405-eng-48. 11p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

A process for the fabrication of lithium-drifted silicon radiation detectors with thin entrance windows is described. High-resistance p-type silicon is diffused, drifted, and processed to form devices useful in a wide range of charged-particle and low-energy gamma experiments. (auth)

42721 (UCRL–16286) STATUS AND FUTURE PLANS FOR LRL FLYING SPOT DIGITIZER. White, Howard S. (Lawrence Radiation Lab., Univ. of California, Berkeley). July 1965. Contract W-7405-eng-48. 17p. (CONF-650510–13). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Conference on Instrumentation for High Energy Physics, Lafayette, Ind.

A review of Berkeley's Flying Spot Digitizer FSD system and its operational components is presented. The FSD consists of a Hough-Powell Device attached online to an IBM 7090 II computer having two cores, discs, and five channels. Measurement times are given for various bubble chambers. Several new developments with the FSD are reported. (M.O.W.)

42722 (CEA-tr-A-1750) EMPLOI DE DOSIMETRES EN VERRE DANS LES CHAMPS DE RADIATION MIXTE. (Use of Glass Dosimeters in Mixed Radiation Fields). Piesch, E. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Translated by M. Garber. 1963. Dep. mn; JCL, $1.10 fs, $0.80 mn.

The characteristics of silver-activated metaphosphate glass, Yokota glass, as dosimeters are described. Experiments on Yokota glasses were carried out in the presence of various filters in mixed radiation fields of γ rays and slow neutrons. It was shown that by the use of different methods the threshold dose could be determined, the γ and the slow neutrons could be evaluated separately, the total dose in rems could be evaluated, and the total dose of γ plus slow, intermediary, and fast neutrons could be evaluated. (J.S.R.)

42723 ON THE TRACK-WIDTH MEASUREMENTS IN NUCLEAR EMULSION. Pniewski, T.; Soltan, M.; Soltynski, K. (Univ. of Warsaw; Inst. of Nuclear Research, Warsaw). Acta Phys. Polon., 27: 905-11(June 1965).

A method of charge determination by measuring the width of tracks with small dip angle and short length was elaborated for particles of $Z \leq 5$ coming to rest in nuclear emulsion. The resolving power of the method was investigated for three magnifications: ×4400, ×11000 and ×2400 and for four different residual ranges of length: 50, 100, 150 and 200/μm. Limits and confidence level of the applied method are given for illustration. (auth)

42724 THE INVESTIGATION OF THE OPERATING PARAMETERS FOR THE XENON GAS SCINTILLATION dE/dx COUNTER. Somorjai, Endre; Koltay, Ede. At. Kozlemen., 7: 37-46(Mar. 1965). (In Hungarian).

During the investigation of the counter the relation between the pulse height and the energy—known earlier only from the extrapolation in the range of low energies—was established. This relation in compliance with our expectation and in disagreement with the extrapolation data does not show threshold-effect. This statement is valid for the xenon gas scintillation counters in general, not only for the special case of dE/dx detectors. The pulse height was measured as a function of the pressure being used the field strength of the employed electrostatic field as a parameter. The effect of the increase of the pulse height caused by the electric field was found to be in agreement with the measurements of others, discrepancy can be seen only at low field strengths, probably because of the different impurities of the gases. (auth)

42725 ADVANCES IN SCINTILLATION AND SEMICONDUCTOR RADIATION DETECTION. Atomics, 18: 11-19(July-Aug. 1965).

Progress in methods of detecting and measuring ionizing radiation using lithium-drifted germanium diodes is reviewed along with improvements to photomultipliers. Scintillation detector development is described. (M.C.G.)

42726 THE USE OF THRESHOLD DETECTORS TO DETERMINE CHANGES IN A FAST NEUTRON ENERGY SPECTRUM WITH DEPTH IN A PHANTOM. Field, S. B.; Parnell, C. J. (Hammersmith Hospital, London). Brit. J. Radiol., 38: 618-21(Aug. 1965).

Experiments were carried out with threshold activation detectors in a tissue equivalent phantom, to determine the effect of the phantom on the energy spectrum of a broad and a narrow beam of fast neutrons obtained from a cyclotron. The detectors were chosen with activation thresholds covering the required energy range (about 0 to 19 Mev), and also to give sufficient induced activity for a reasonable irradiation time. Discs of the detector materials were irradiated at various depths within the phantom, up to 30 cm. The decay curve for each was determined, and compared with that of the detectors irradiated in air. The results indicate that the beam hardens slightly at increasing depths The spectral change is slightly greater for the narrow beam than for the broad beam, but in either case is probably insufficient to cause any significant change in relative biological effects. (auth)

42727 A LOW WEIGHT SCINTILLATION COUNTER WITH FOCUSING COLLIMATOR. Glaister, D. H. (Royal Air Force Inst. of Aviation Medicine, Farnborough, Hants, Eng.). Brit. J. Radiol., 38: 625-8(Aug. 1965).

Design features are described of a low-weight scintillation counter with focusing collimator design for use in studies of the distribution of blood and gas within the lungs using ^{133}Xe as a tracer. Performance was tested in a lung phantom in which the position of the ^{133}Xe source was moved within the phantom. The off-axis sensitivity of the focusing collimator was determined using the same point source of ^{133}Xe at distances of 10 and 17 cm from its front surface. (C.H.)

42728 AN EXAMINATION OF THE DEFINITION AND MAGNITUDE OF BACK-SCATTER FACTOR FOR ^{60}Co GAMMA RAYS. Cunningham, J. R.; Johns, H. E.; Gupta, S. K. (Ontario Cancer Inst., Toronto). Brit. J. Radiol., 38: 637-8(Aug. 1965).

A recent set of measurements of tissue-air ratios for large field sizes (Gupta and Cunningham, 1965) for ^{60}Co γ rays has brought to light some inconsistencies in the currently accepted definition of back-scatter factor. It has also

been noted that the most widely published values for back-scatter factors (and therefore tissue-air ratios and scatter functions) for this radiation contain a small but persistent systematic error. The published values of back-scatter factor (Kemp and Cohen, 1961) are given as the limiting case of tissue-air ratio when the depth in the phantom reduces to that just great enough to provide electronic equilibrium. Tissue-air ratio is defined in terms of absorbed dose and the reference condition is taken as the absorbed dose in a small portion of phantom material just large enough to establish electronic equilibrium. Back-scatter factor (ICRU, 1963), on the other hand, is defined in terms of exposure and is the ratio of the ionisation caused in a cavity at the equilibrium depth in a phantom, to the ionisation that would be caused at the same point in space under the same irradiation conditions. Although many have felt that these two definitions reduce to the same value at the equilibrium depth, it is clear that they cannot, for they refer to different physical conditions. In the former case a large phantom is paired with a small phantom and in the latter case the same large phantom is paired with free air. The difference between them would be a factor which would describe attenuation and scatter within the small reference phantom. This factor is allied to the cap correction factor which has received much discussion in recent literature. To illustrate the anomaly it may be pointed out that back-scatter factor as defined in terms of exposure (ICRU, 1963) would reduce to $\exp(-\mu \times 0.5)$ for a field of zero area, which would produce a value close to 0.967 instead of the 1.00 that one would expect from the term back-scatter factor. The problem of inconsistency of definition could be resolved by redefining scatter factor solely in terms of absorbed dose and, if this were done, scatter factor, or back-scatter factor, would truly become a special case of tissue-air ratio. A change in definition would require the review of published back-scatter values and when this is done it is found that the values reported for ^{60}Co radiation do not conform to either definition because they were not actually made at the equilibrium depth. Measurements were made at the surface of the phantom by a "half-immersion technique" by Kemp and Burns (1958) and by Dixon, Garrett and Morrison (1952). The values published by Kemp and Cohen (1961) are those due to Johns, Morrison and Whitmore (1956) as included in tumor-air ratio but were actually taken from Dixon's work. When these values were produced it was assumed that back-scatter measured at the surface of the phantom would be the same as back-scatter measured at the peak of the build-up curve. This is not quite correct and a small but systematic error results. (auth)

42729 MEASUREMENT OF THE ABSOLUTE YIELD OF NaI(Tl) DURING γ-LUMINESCENCE. Pertsev, A. N.; Pisarevskii, A. N.; Soshin, L. D. (Belorussian State Univ., USSR). Dokl. Akad. Nauk BSSR, 9: 299-300(May 1965). (In Russian).

The absolute light yield of NaI(Tl) crystals 10 × 10 mm was determined by comparing the scintillation amplitude with the amplitude of a single-electron pulse (corresponding to the escape of a single electron from the photocathode) at the exit of a photomultiplier photocathode tube. Corrections were made for light losses due to reflection, absorption of light in the walls of the glass tube and vaseline coupling agent, the quantum yield of the photocathode, and the collection of photoelectrons at the first dynode. The number of light quanta occurring in the crystal during absorption of a gamma quantum is given by the formula: $N = C^{-1}\mu^{-1}(\epsilon\eta)^{-1}(A_p/A_e)$. Here C is the light yield in the crystal corrected for reflection losses; μ is the optical attenuation coefficient due to light absorption in the glass walls and the vaseline coupling agent; ϵ is the average quantum yield of the photocathode and η is the coefficient of photoelectron collection at the first dynode. A_p is the average amplitude of the photopeak, and A_e is the average amplitude of a single-electron distribution. The absolute energy yield of the crystal is $x = \bar{E}N/E_\gamma$. Here E_γ is energy of the gamma quantum, and $\bar{E}$ is the average photon energy. With gamma quanta from ^{137}Cs it was found that $A_p/A_e = 1764 \pm 3\%$ photoelectrons; $\epsilon\eta = 8.2 \pm 0.08\%$; $\mu = 96.4 \pm 1\%$, and $c = 70 \pm 2\%$. Then, N = 31,900 ± 7% quanta; N/E = 5.0 ± 0.4% quanta/ev, and the energy yield of the crystal is x = 15.3 ± 1%. (TTT)

42730 USE OF MOS AND FET TRANSISTORS IN AN ION CHAMBER PORTABLE SURVEY METER. Manfredi, P. F.; Maranesi, P.; Rimini, A.; Terrani, S. (CESNEF, Milan). Energia Nucl., 12: 484-7(Sept. 1965).

A portable survey meter for x and γ rays is described. The electrometer circuit employs only solid state components. The linearity and stability measurements were quite satisfactory. (auth)

42731 ANGULAR DEPENDENCE OF EASTMAN TYPE A (NTA) PERSONNEL MONITORING FILM. Kathren, Ronald L.; Prevo, Charles T.; Block, Seymour (Univ. of California, Livermore). Health Phys., 11: 1067-9(Oct. 1965). (UCRL-12199).

In the United States, the Eastman Type A (formerly NTA) film packet is widely used to monitor personnel exposures to fast neutrons. Response of Eastman Type A Personnel Monitoring Film was found to be a function of the angle of incidence of a neutron with the plane of the film. The angle of maximum response was a function of the energy of the incident neutron. A factor was found that corrects for the effects of angular dependence and fast-neutron energy on the track per field dose. (auth)

42732 ACCURACY AND SENSITIVITY OF FILM MEASUREMENTS OF GAMMA RADIATION. PART IV. INTRINSIC AND EXTRINSIC ERRORS. Brodsky, Allen (Univ. of Pittsburgh); Spritzer, Albert A.; Feagin, Frederick E.; Bradley, F. J.; Karches, Gerald J.; Mandelberg, Hirsch I. Health Phys., 11: 1071-82(Oct. 1965).

Results are summarized from laboratory and field studies of a project aimed at assessing the overall accuracy, sensitivity, and sources of error in film dosimetry of gamma radiation. Taken together, these studies present a strong implication that properly designed and processed film badges are inherently capable of monitoring the long-term cumulative whole-body gamma exposure of individual radiation workers at levels one-tenth or less of the recommended limits of permissible occupational exposure. Further, the retrospective exposure record studies and field studies indicate that estimates of average population exposure to groups of radiation workers receiving annual exposures of 100 mR or more may in some cases be obtained within 10 to 20 per cent of the true value from existing personnel exposure records. (auth)

42733 MAGNETIC TAPE RECORDING OF GAMMA RAY SPECTRA. Geilker, Charles Don (Vanderbilt Univ., Nashville). Health Phys., 11: 1092-4(Oct. 1965).

The use of magnetic tape for recording data on γ spectra was investigated. Results are reported using a high quality commercial tape recorder, a scintillation detector, and a multichannel analyzer. Spectra of ^{22}Na, ^{137}Cs, ^{54}Mn, and ^{60}Co were recorded. On playback, the output from the tape recorder was applied to the input of the scintillation detector's cathode follower, just as though the pulses were originating in the crystal and photomultiplier. No attempt was made to alter the tape recorder's equalization characteristics in either the record or playback mode, and only the fine gain control of the multichannel analyzer was advanced to compensate for the loss in signal strength. Counting rates from a few hundred up to ten or twenty thousand counts per minute were used, and the only calibration of the multichannel analyzer involved manipulating its front panel zero-level control during playback of a known tape (^{137}Cs) to make the peak appear in the desired channel. Results indicate that, for applications where high resolution is not of the utmost importance, analogue tape recording might permit taking only the scintillation detector and tape recorder into field operations which pose environmental hazards to the complexities of analogue-to-digital conversion. In laboratory situations, it could greatly increase the efficiency of time utilization of multichannel analyzers by permitting initial data acquisition at low count rates to be done onto either a recirculating closed loop of tape from which all accumulated information could be removed in a single pass during playback or onto single pass

tape which could be played back at greatly increased tape transport speed. (C.H.)

42734 MEASUREMENT OF FAST NEUTRON FLUX DENSITY BY MEANS OF AN INDIUM DETECTOR. Aten, A. H. W. Jr.; Heertje, I.; Bonn, R.; Mosk, J. A.; van Westen, N. P.; Kapteyn, Johanna C. (Instituut voor Kernphysisch Onderzoek, Amsterdam). Health Phys., 11: 1094-5(Oct. 1965).

A paraffin sphere (consisting of two half spheres) fitting inside a cubic cadmium box with 15-cm edges and containing a small indium disc, provided a useful neutron flux density integrator. Its sensitivity is roughly independent of neutron energy. Calibration procedures are described. (C.H.)

42735 CRYOGENIC ASPECTS OF THE BRITISH NATIONAL HYDROGEN BUBBLE CHAMBER. Newport, R. W. (National Inst. for Research in Nuclear Science, Chilton, Berks, Eng.). Intern. Advan. Cryog. Eng., 10: 233-42(1965).

The cryogenic aspects of the hydrogen bubble chamber are discussed including the main cryostat, the expansion system, the refrigeration system, and cooling down the chamber windows. (D.C.W.)

42736 CORRECTION OF RATEMETER READINGS WITH VARYING COUNT RATES FOR RESPONSE TIME LAG. Pilgrim, D. H. (Univ. of New South Wales, Sydney). Intern. J. Appl. Radiation Isotopes, 16: 461-72 (Aug. 1965).

When a ratemeter is used to measure count rates varying with time, as in the detection of the passage of labeled material past a point, the readings are in error due to a lag associated with the response time of the ratemeter circuit. Descriptions are given of three methods for correcting the readings to the true count rate for a ratemeter with linear output and a fixed RC time constant over a given range. An iterative procedure was found to be most satisfactory, since difficulties due to fluctuating values often arose with a more direct type of solution. Adaption of the procedures to other types of meters is discussed. Experimental results showed that the iterative method satisfactorily corrects the major portion of the lag error, and the significance of the corrections in interpreting physical phenomena under investigation is discussed. (auth)

42737 CORRECTIONS IN X-γ COINCIDENCE MEASUREMENTS. Hiscott, J. E. (Atomic Energy Research Establishment, Wantage, Berks, Eng.). Intern. J. Appl. Radiation Isotopes, 16: 501(Aug. 1965).

In coincidence counting technique for standardization of electron capture nuclides, which emit a γ ray coincident with the capture event, there are two forms of the single-channel count-rate equations for use in different circumstances. These equations are discussed. (F.J.H.)

42738 CORRECTIONS IN X-γ COINCIDENCE CALIBRATIONS OF E. C. RADIONUCLIDES. Houtermans, H.; Petel, M. (International Atomic Energy Agency, Vienna). Intern. J. Appl. Radiation Isotopes, 16: 501-2(Aug. 1965).

Mathematical corrections in x and γ ray coincidence standardizations of electron-capture radionuclides are discussed. (F.J.H.)

42739 INCREASED SENSITIVITY OF A RADIOACTIVE IONIZATION DETECTOR. Bourke, P. J.; Dawson, R. W.; Denton, W. H. (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Chromatog., 19: 425-7(Aug. 1965).

A technique for chromatographic analysis of trace mixtures of permanent gases in helium using purified helium as a carrier and a radioactive ionization detector was studied. Specifically, the variation in detector sensitivity to oxygen with voltage was investigated. It was found that an increase in the voltage applied to the detector improved its sensitivity. (D.C.W.)

42740 INVESTIGATIONS ON THE RESOLUTION POSSIBILITIES AND PULSE YIELDS OF TWO NaI(Tl) CRYSTALS OF DIFFERENT SIZES IN COMBINATION WITH A SCINTISCANNER. Rudat, W. G.; Stroetges, M. W. (Universitaet, Muenster, Ger.). Nucl.-Med., 4: 445-53(1965). (In German).

Two detector heads used for scanning, differing in crystal size and collimator design, were compared. Employing pulse height analysis for ^{131}I, the counting efficiency with a NaI (Tl) crystal of 4.5 cm diameter and 5 cm thickness, lead-shielding of 3.5 cm, and a focusing collimator was 3.2 times better than with a crystal of 2 cm diameter and 2 cm thickness, lead-shielding of 2.5 cm, and a conical single-hole collimator. Resolution for extended volume sources was similar in both situations, but was better with the larger detector for extended plane sources because the scanned organs were better delineated. (auth)

42741 STEERABLE PROBE WITH A MINIATURE GEIGER-MUELLER COUNTER FOR DETECTION OF STOMACH TUMORS. Andrysek, Oskar; Kaufmann, Guenther; Gregor, Ota (Charles Univ., Prague; Robert-Roessle-Klinik, Berlin; Medical Clinic, Prague). Nucl.-Med., 4: 454-9(1965). (In German).

A controllable gastric probe for cancer diagnosis is described. It is equipped with a miniature beta-counter at its tip. The movement of the tip is brought about by four steel wires at the circumference of the spiral of the probe. The probe can be positioned over the suspected area in the stomach under fluoroscopic control and can be used for the diagnosis of malignancy by means of radiophosphorus. The excellent flexibility of the probe makes possible measurements in the subcardial region. (auth)

42742 COMPARISON TABLE OF THE PERFORMANCE OF TWENTY-FIVE TYPES OF RADIATION DETECTOR. Clarke, F. J. J. (National Physical Lab., Teddington, Eng.). Photochem. Photobiol., 3: 91-6 (June 1964).

Characteristics of radiation detectors, for wavelengths ranging from 0.2 μ to several hundred μ, are reviewed. Difficulties associated with intercomparing the performances of different types of radiation detector are discussed, as well as the best figure of merit to apply to a wide variety of detector types. A table gives current data on the best performance achieved by 25 basic types of radiation detector, in terms of spectral response, usable frequency range, spatial resolution (where appropriate), and sensitivity. Sensitivity is listed under two headings: the minimum detectable signal, expressed in fundamental units (w, w cm^{-2}, j or j cm^{-2}); and the output sensitivity, which indicates the kind and magnitude of output and which is accordingly expressed in practical units. Source references are given to cover all detector types listed. There is no single parameter which adequately assesses the relative performance of different detectors, particularly if their spectral responses peak in different parts of the spectrum. A multiplicity of units is used in practice to describe the performance of various types. It is not possible to adopt a universal criterion of performance for all detectors. The response times of detectors are of great significance in many applications, and the table indicates the usable frequency range attained in practice with the various detectors. (BBB)

42743 STUDY OF THE OBLIQUE TRACKS IN A SPARK CHAMBER. Novikov, L. S. Pribory i Tekhn. Eksperim., No. 4, 45-8(July-Aug. 1965). (In Russian).

The efficiency of spark chambers with electrode gaps of approximately 60 mm was considered. The form of the spark coming from oblique particle tracks was investigated. Light and dark sections were observed on the shaft of the spark. (tr-auth)

42744 PROPORTIONAL COUNTER FOR SPECTROMETRIC STUDY OF NUCLEAR REACTION PRODUCTS. Malov, M. M.; Milikov, Yu. V.; Tulinov, A. F. (Moscow State Univ.). Pribory i Tekhn. Eksperim., No. 4, 51-4 (July-Aug. 1965). (In Russian).

A proportional counter designed for the detection of charged products of nuclear reactions was described. The results of tests of the apparatus with a Cm source and on a cyclotron were given. The question of the selection of the optimum admixture of the polyatomic gas (CO_2) to the

Ar, the counter filler, was investigated in detail. The resolution limit of the counter for α particles of ^{242}Cm (E_α = 6.1 Mev) does not exceed 1.5%. (tr-auth)

42745 RESONANCE COUNTER WITH Mg_2Sn SOURCE FOR RECORDING ^{119}Sn γ RAYS. Mitrofanov, K. P.; Plotnikova, M. V.; Rokhlov, N. I. (Moscow State Univ.). Pribory i Tekhn. Eksperim., No. 4, 55-8(July-Aug. 1965). (In Russian).

A resonance counter for the recording of recoilless γ rays of 23.8-kev from $^{119*}Sn$ was developed on the basis of Mg_2Sn compounds. Investigation showed that during operation on resonance counters the capacity increased but the width of the lines decreased. Experimental lines with a width of 0.52 mm/sec were less wide than the most narrow (theoretical) lines calculated for the usual methods of detection. (tr-auth)

42746 CHARACTERISTICS OF IK-6 IONIZATION CHAMBER. Kirillov-Ugryumov, V. G.; Petukhin, A. A.; Shestakov, V. V. (Moscow Inst. of Engineering Physics). Pribory i Tekhn. Eksperim., No. 4, 59-62(July-Aug. 1965). (In Russian).

The potential distribution across the chamber was measured. The coefficients of the electron collection were measured for different sections of the chamber and times of electron collections. The efficiency of the operation and time collection of electrons was experimentally determined. (tr-auth)

42747 LIQUID SCINTILLATION DETECTOR OF FISSION AND RADIATIVE CAPTURE. Wang, Shih-ti; Ryabov, Yu. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 4, 63-70(July-Aug. 1965). (In Russian).

A liquid scintillation detector with approximately 400 l volume with cadmium propionate solution, designed for the study of parameters of fissioning nuclei in time-of-flight experiments, was described. The detector can record fissions with efficiency up to 50% and radiative capture efficiencies up to 40%. The detector makes it possible to work with samples weighing several g/cm^2. (tr-auth)

42748 LIQUID SCINTILLATION NEUTRON DETECTOR WITH PHOTOMULTIPLIER COOLING. Popov, A. B.; Yazvitskii, Yu. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 4, 70-2 (July-Aug. 1965). (In Russian).

A boron-containing liquid scintillation neutron detector of high efficiency with a surface of 500 cm^2 was described. The lifetime of neutrons in the detector is about 2μsec. (tr-auth)

42749 CHARACTERISTICS OF VARIOUS FLAT SCINTILLATION DETECTORS FOR SLOW NEUTRONS. Tsirlin, Yu. A.; Chernikov, V. V.; Timofeeva, T. V. (All-Union Research Inst. of Monocrystals, Khar'kov). Pribory i Tekhn. Eksperim., No. 4, 72-4(July-Aug. 1965). (In Russian).

The absolute effectiveness for slow neutron detectors was measured using the scintillation compounds T-1 and T-2 and some foreign detectors using B_2O_3 + ZnS(Ag). The relation of the neutron and γ effectiveness of the detectors was investigated. The superiority of the detectors using T-1 and T-2 was shown. (tr-auth)

42750 RESOLVING POWER OF NaI(Tl) MONOCRYSTALS. Kibal'chich, G. A.; Belogurov, Yu. P.; Lukashenko, L. V. (All-Union Research Inst. of Monocrystals, Khar'kov). Pribory i Tekhn. Eksperim., No. 4, 75-7(July-Aug. 1965). (In Russian).

The results of the study of the resolving power of monocrystals of NaI(Tl) with a diameter of 30 mm in commercial packing and with special hydrogen layer reflectors easily applied to the monocrystals were reported. The measurements were made with the FEU-13 in dry boxes. It was shown that the resolution strongly depends on the homogeneity of the reflection coefficients of the reflection surface which depends on the degree of compression of the magnesium oxide powder. Therefore the resolution of monocrystals of NaI(Tl) can be considerably impaired by the packing as was observed. The hydrogen layer reflector has high homogeneity of the reflection coefficient, guaranteeing improvement of the resolutions. (tr-auth)

42751 INVESTIGATIONS OF A LARGE PLASTIC SCINTILLATOR. Yudin, E. P.; Dovzhenko, O. I.; Denisov, E. V. (Inst. of Physics, Moscow). Pribory i Tekhn. Eksperim., No. 4, 77-82(July-Aug. 1965). (In Russian).

The methodics of work with a plastic scintillator with large dimensions (100 × 100 × 10 cm^3) were described. The logarithmic amplifier with large amplification range for the pulse to be amplified was considered. The probable size of the pulse produced by passage through the scintillator of a single μ meson was determined. Different conditions for the pulse collection were investigated. (tr-auth)

42752 PULSED GENERATORS FOR SUPPLYING SPARK CHAMBERS. Korenchenko, S. M.; Nekrasov, K. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 4, 120-3(July-Aug. 1965). (In Russian).

The diagrams of a thyratron generator and a generator with controllable discharge for supplying large capacity spark chambers were described. Methods were examined that make it possible to increase delay of wear in commutation circuits of high voltage pulses by 30 to 35 nsec in circuits of discharge generators and by 70 to 80 nsec in thyratron generators. (tr-auth)

42753 GENERATOR OF HIGH-VOLTAGE PULSES WITH SHORT SIGNAL DELAY FOR SPARK CHAMBER STARTUP. Tomashchuk, Yu. F.; Radkevich, I. A. (Inst. of Experimental and Theoretical Physics, Moscow). Pribory i Tekhn. Eksperim., No. 4, 123-6(July-Aug. 1965). (In Russian).

Two circuits of high voltage pulse generators for supply of spark chambers were described. The high voltage pulse front under 700 nf load is no more than 30 nsec. The maximum delay from the moment of introduction of the delayed signal to the moment of generation of high voltage pulse is no more than 40 nsec. (tr-auth)

42754 A DEVICE FOR STUDYING EPR SPECTRA ON 21 CM WAVE DURING FAST ELECTRON IRRADIATION. Blazhevich, I. N.; Buben, N. Ya.; Malyshko, A. N. (Inst. of Chemical Physics, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 4, 134-5(July-Aug. 1965). (In Russian).

The device for observing the electron paramagnetic resonance spectra on the 21 cm wavelength during irradiation with fast electrons was described. The magnetic field was created by solenoids, along the axis of which the electron beam was introduced. The temperature of the samples can be varied from –180 to +100°C. (tr-auth)

42755 THE DEPENDENCE OF AMPLIFICATION OF SPECTROMETRIC PHOTOMULTIPLIERS ON THE LOAD. Burmistrov, V. R.; Kiselev, B. G. (Inst. of Nuclear Physics, Alma-Ata, USSR). Pribory i Tekhn. Eksperim., No. 4, 164-6(July-Aug. 1965). (In Russian).

During spectrometric work on scintillation spectrometers in cases of variable load (energy calibration of the spectrometer, measurement of the background, etc.) significant distortions of the spectral results can result from the dependence of the amplification coefficients of the photomultiplier on the load. For maintaining the amplification coefficients of the photomultiplier constant during the forced measurement of the load, it is recommended that the central anode current of the photomultiplier be maintained constant by artificial methods. The stability of the anode current to several per cent preserves constant the amplification coefficient for photomultipliers of the type FE11-11, -13, and -34 exact to more than ±0.5%. (tr-auth)

42756 PLASTIC SCINTILLATORS WITH PENTAPHENYL. Matveeva, E. N.; Medvedev, M. N.; Rubina, O. G.; Shafranov, M. D. (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 4, 227-8 (July-Aug. 1965). (In Russian).

Data on the investigation of the scintillation properties of pentaphenyl during its introduction in polystyrene both as a basic filler and as a "shifting" admixture to p-terphe-

nyl were reported. The pulse amplitude was measured during irradiation with ^{60}Co γ rays. It was established that scintillators containing 2% p-terphenyl + 0.05% pentaphenyl and polystyrene had the maximum pulse amplitude, being 0.09 of the pulse amplitude of stilbene. (tr-auth)

42757 SURFACE-BARRIER p-TYPE SILICON PARTICLE COUNTERS. Lazarev, V. A. (Inst. of Physics of Semiconductors, Novosibirsk, USSR). Pribory i Tekhn. Eksperim., No. 4, 225(July-Aug. 1965). (In Russian).

A surface-barrier p-type silicon counter with a gold coating was prepared. The efficiency and resolution of the counter was investigated using ^{210}Po alpha particles. The performance was compared with detectors using n-type surface barrier materials. (C.E.S.)

42758 CONFIDENCE TEST OF RADIATION COUNTER BY STATISTICAL METHOD. Koyanagi, Takami (Niigata Univ., Nagaoka, Japan). Radioisotopes (Tokyo), 14: 279-85(July 1965). (In Japanese).

Several types of methods for statistical confidence test of radiation counters are discussed. The χ^2-goodness-of-fit test is most familiar among them, but it has the demerit that the results of the test are fairly affected by the way of dividing the data into classes. The modified χ^2-test also has the same shortage as χ^2-test. Though the ω^2-test is not affected by the way of dividing the data, it does not give the significance level. It was found by comparison that the likelihood ratio test is the best for the confidence test. By using the last method, the critical region and the power curves of the confidence test are given in three diagrams. Lastly the counting results are plotted on the probability paper from which the goodness-of-fit can be estimated. (auth)

42759 A SOLID-STATE ELECTROMETER AND ITS APPLICATION TO β RAY THICKNESS GAGE. Katagiri, Michio; Yamasaki, Hiro (Yokogawa Electric Works Ltd., Japan). Radioisotopes (Tokyo), 14: 293-9(July 1965). (In Japanese).

An all solid-state pre-amplifier (ionization-current amplifier) for β ray thickness gage was designed and was proved ideal for process automation by the actual applications. The amplifier which is called "Pico-diode electrometer" has the following characteristics. It has no drift (less than 2×10^{-15} amp/°C at 0 ~ 50°C) immediately after switching on for almost eternal period in the sensitivity of $10^{-11} \sim 10^{-12}$ amp through the input resistor of more than 10^{10} ohm. The circuit is a type of parametric oscillating amplifier which gives high gain and excellent stability with a simple circuit. This new solid state electrometer makes β gage more reliable than ever before on the process application. The principle of the parametric oscillating amplifier, its characteristics and the system of the β ray thickness gage with the electrometer are described. (auth)

42760 A SIMPLE γ-RAY DOSE THRESHOLD DETECTOR USING A DYE. Asada, Tsunesaburo; Kikuchi, Riichi; Tomita, Akihiro; Terai, Kiyoshi (Osaka Univ.). Radioisotopes (Tokyo), 14: 300-2(July 1965).

A low cost, simple, convenient and quick readout dose detector whose color change indicates a threshold dose is developed. This detector is a paraffin base film made from polyvinyl chloride (PVC) powder and Congo red. The detector is based on the liberation of chlorine from PVC under irradiation, proportional to absorbed dose, leading to the formation of acid which can cause color change of Congo red. The H^+-ion yield from PVC powder (mean grain size = 120 microns) by irradiation ($G[H^+]$-value) is determined from the pH-value of irradiated PVC powder in water. The film made from PVC powder 50 wt %, Congo red 0.1 wt % and paraffin 50 wt % shows a distinct color change at 3×10^4 r of γ-irradiation, where the dose rate is 6.5×10^4 r/hr. It is possible to make a film which changes its color at a higher threshold dose by adding NaOH in Congo red in advance. This threshold dose where color change of the detector initiates is able to be controlled by changing an amount of NaOH. Properties of this detector are reported. (auth)

42761 STUDIES ON THE REPRESENTATION OF SCINTIGRAM. Maeda, Tatuo; Yoshimoto, Seiichi; Oshiumi, Yoshihiko (Kyushu Univ., Japan). Radioisotopes (Tokyo), 14: 324-7(July 1965). (In Japanese).

An apparatus for color translation of scintigram was described. The apparatus produces a pattern of 8 colors related to the density of dots of scintigram. Quantitative information is obtained because the color change with dots density transverse the area. The apparatus also has an advantage that color translation of the previously obtained usual black dots scintigram is possible. Furthermore, this technique is useful to convert the density of film to the isodose color patterns, in the measurement of depth dose distribution in daily radiotherapy. (auth)

42762 MONITORED BEAM X RAY ABSORPTION SPECTROMETER. Panson, Armand J.; Kuriyama, Masao (Westinghouse Electric Corp., Pittsburgh). Rev. Sci. Instr., 36: 1488-9(Oct. 1965).

A monitored beam x-ray absorption spectrometer arrangement is described. With this geometry inaccuracies in determining absorption coefficients due to fluctuating source intensity are eliminated. In the spectrometer, the incident x-ray beam passes first through a monitor counter and then through the absorber specimen to a detector counter. The arrangement was tested experimentally using two commercial mica side-window proportional counters. (auth)

42763 GOLD PLATING PROCEDURE FOR A THIN WINDOW ON GERMANIUM γ RAY SPECTROMETERS. Janarek, F. J.; Helenberg, H. W.; Mann, H. M. (Argonne National Lab., Ill.). Rev. Sci. Instr., 36: 1501-2(Oct. 1965).

A procedure is described for depositing an adherent gold layer on germanium by the use of a potassium gold cyanide solution. The characteristics of thin-window germanium detectors prepared with the use of this technique are summarized. (D.C.W.)

42764 RESOLVING TIME DETERMINATIONS OF NUCLEONIC DETECTORS. Marais, P. G.; Smit, W. B. de V.; Deist, J.; Haasbroek, F. J. (Fruit and Fruit Technology Research Inst., Stellenbosch, S. Africa). S. African J. Agr. Sci., 7: 603-10(1964).

A method is described for determining the resolving times of nucleonic detectors by comparing the relative activities and observed counting rates of a number of sources. The method is compared with the two-source method, and their respective merits are discussed. (TCO)

42765 A LARGE AREA TRANSMISSION DETECTOR AND ITS APPLICATION FOR THE MEASUREMENT OF THE POLARIZATION OF FAST NEUTRONS. Buesser, F. W.; Christiansen, J.; Hermsen, H. P.; Niebergall, F.; Soehngen, G. (Institut fuer Experimentalphysik, Hamburg). Z. Physik, 187: 243-61(1965). (In German).

The characteristic features of a parallel-plate avalanche counter are described. Using extremely thin foils as electrodes, this counter can be designed as a large-area transmission detector for the measurement of dE/ds of ionizing particles. A telescope consisting of three parallel-plate avalanche counters was used for the measurement of the polarization of fast neutrons employing $n-\alpha$ scattering as the analyzing reaction. The experimental methods of these measurements are discussed. (auth)

42766 APPARATURA DLYA REGISTRATSII I ISSLEDOVANIYA IONIZIRUYUSHCHIKH IZLUCHENII. Spravochnik. (Devices for Recording and Investigations of Ionizing Radiation. Handbook). Egorov, I. M.; Zhernov, V. S.; Lazarev, A. F.; Perov, N. L.; Timofeev, A. A. Moscow, Atomizdat, 1965. 430p.

The handbook describes various experimental apparatuses, installations, photomultipliers, scintillators, Geiger counters, ionization chambers and other instruments manufactured in USSR. Specifications are given of devices for individual dosimetric control, radiation dosimetry, and for determining the radioactive contamination of working areas and water. Aerosol monitoring instruments and multichannel pulse analyzers are also described. (R.V.J.)

42767 IMPROVEMENTS IN OR RELATING TO PHOTOCONDUCTIVE RADIATION DETECTORS. Attix, Frank

Herbert. British Patent 997,183. July 7, 1965. Priority date May 29, 1961, United States.

A photoconductive radiation detector is comprised of three parts: a photoconductive element adapted to be connected into an electric circuit; a light source provided by a radioactively excited luminescent material positioned relative to the photoconductive element and having an energy sufficient to fill electron traps in the photoconductive element; and means for indicating, when the detector is in use, a current flow in the circuit resulting from detected light or ionizing radiation. The light source is secured on or near the photoconductive element. A radioactive phosphor comprising two distinct layers, one of a phosphor and one of a radioactive material, is used as a light source. At least a part of the radioactive phosphor is coated upon the photoconductive element. The photoconductive element is contained within an envelope coated upon the inner surface with the phosphor. The envelope is of opaque material and is provided with a window giving access to the photoconductive material to light emanating outside the envelope. (B.L.M.)

42768 SOLID STATE RADIATION DETECTOR. Lindsay, William F. (to U. S. Atomic Energy Commission). U. S. Patent 3,205,357. Sept. 7, 1965.

A solid state radiation detector is designed for measuring fast transient gamma radiation fields wherein a bias voltage potential is imposed across a semiconductor p-n junction device so as to substantially eliminate the neutral region and thereby improve the response time of the detector. (AEC)

Radiation Effects

42769 (AD-607533) AUTOMATED DIGITAL COMPUTER PROGRAM FOR DETERMINING RESPONSES OF ELECTRONIC SYSTEMS TO TRANSIENT NUCLEAR RADIATION. VOLUME I. DEVELOPMENT AND APPLICATION OF DIGITAL COMPUTER PROGRAMS. (International Business Machines Corp., Oswego, N. Y. Radiation Effects Dept.). Aug. 1964. Contract AF29 (601)-5399. 147p. (WL-TDR-64-62(Vol.I)). CFSTI $4.00 cy, $1.00 mn.

The development of digital computer programs for automated circuit and component analysis is reported. This work resulted in the development of the PREDICT and TREAT programs for the IBM 7090. PREDICT is an automated digital computer program for determining transient circuit response which will accept a topological description of a large circuit, evolve and solve the necessary circuit equations, and produce the time history of specified voltages and currents. Transistors, diodes, and capacitors in transient radiation environments are represented by equivalent circuits. TREAT is a system of six programs for the automatic processing of data on the effects of transient and steady-state radiation on transistor, diode, and capacitor parameters. The program treats actual and typical device information, evaluates permanent damage to devices, and processes dosimetry information. From actual or typical radiation environment and device data, the theoretical response of certain important device parameters during irradiation can be computed. This output of TREAT can be used directly as an input to PREDICT. (auth)

42770 (NASA-TN-D-2919) EFFECT OF ELECTRON RADIATION ON TV LENS COMPONENTS. Kobren, Lawrence (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Sept. 1965. 9p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Optical glasses similar to those which will be used as lens materials in the TV camera system of the Nimbus satellite were exposed to 1- and 2-Mev electrons to determine the effect of electron bombardment on their optical properties. The electron flux used was 4.5×10^{11} electrons/cm^2-day which approximates the orbital environment of the satellite. Results indicated a significant reduction in the optical transmissivity of the glasses during exposure. However, it was found that damage to the glass could be significantly reduced with the use of a protective coverplate made from from radiation resistant fused silica. (auth)

42771 (SC-R-65-941) METHODS FOR MEASURING AND CHARACTERIZING TRANSISTOR AND DIODE LARGE SIGNAL PARAMETERS FOR USE IN AUTOMATIC CIRCUIT ANALYSIS PROGRAMS. Sullivan, W. H.; Wirth, J. L. (Sandia Corp., Albuquerque, N. Mex.). July 1965. Contract AT(29-1)-789. 17p. (CONF-650707-3). Dep. mn; CFSTI, $1.00 cy, $0.50 mn.

From IEEE Annual Conference on Nuclear and Space Radiation Effects, Ann Arbor, Mich.

The mathematical bases of the Ebers-Moll, Charge-Control and Linvill models are discussed in order to establish the parameter requirements and the accuracy of these models. A recovery technique for measuring those parameters associated with minority carrier storage in devices is described and typical values are given for several high frequency devices. Other parameters, such as current gain and junction depletion capacitance, do not require special measurement procedures and in these cases the characterization of the bias dependence of the parameter is given primary emphasis. The use of the recovery technique in characterizing permanent radiation (neutron) damage and in studying damage mechanisms in transistors is also discussed. (auth)

42772 (UCRL-16061) ALPHA-VOLTAIC STUDY OF THE RADIATION DAMAGE IMPARTED BY 4-Mev ALPHA-PARTICLES TO Si SOLAR CELLS (thesis). Poksheva, John G. (Lawrence Radiation Lab., Univ. of California, Berkeley). June 1965. Contract W-7405-eng-48. 150p. Dep. mn; CFSTI $4.00 cy, $1.00 mn.

The effects of 4 Mev α-particle bombardment upon P on N and N on P Si solar cells are investigated. Current-voltage characteristics are obtained before, during, and after bombardment. These characteristics are analyzed in terms of anticipated radiation damage manifestations. Base-region diffusion length degradation constants are determined from α-illuminated short-circuit current measurements. These constants are compared with those having been found for proton bombardment. This comparison is found to be in qualitative agreement with atomic displacement phenomena predicted by classical Rutherford scattering. (auth)

42773 ON THE EFFECT OF ION COUNTER GENERATED IONS ON THE KINETICS OF PHOTOSTIMULATED EXOELECTRON EMISSION FROM PLASTICALLY DEFORMED ALUMINIUM. Sujak, B.; Gieroszynski, A.; Mader, J. (Wroclaw Univ., Poland). Acta Phys. Polon., 28: 31-43(July 1965).

Photostimulated exoelectron emission as recorded in gases and accompanying plastic deformation of aluminum is known to exhibit various kinetics according to the experimental conditions. By consecutive elimination, the effect of essential parameters, thus the light stimulating emission, the accelerating voltage between the specimen and grid cathode of the counter, and the working voltage of the counter itself, was investigated. The initial intensities of emission $(N/t)_{0,i}$ on reintroducing a given parameter i into the recording system were found to depend markedly on the time $t_{w,i}$ during which the parameter in question had been eliminated for the case of elimination of the working voltage U_l of the counter. The experimental results point to ions generated in the active volume of the counter as a factor able to affect the emission kinetics essentially when applying an ion counter for research work in gases and choosing the parameters inadequately, as e.g., excessively intense stimulating light or too high accelerating voltage. (auth)

42774 TESTING OF ELECTRONIC COMPONENTS IN A NUCLEAR ENVIRONMENT. DeCovnick, H.; Nakazato, S. (Aerojet-General Nucleonics, San Ramon, Calif.). J. Environmental Sci., 7: 36-7(Apr. 1964).

An irradiation experiment was performed to demonstrate the effects of a nuclear radiation field upon a silicon-controlled rectifier (SCR) under electrical load, and to

demonstrate the applicability and ease of performing an irradiation program at a low cost in the AGN-201P, a low-power test reactor. This irradiation facility, operating at 20 w, is a compact, self-contained nuclear reactor in which the core consists of 665 g ^{235}U, as 20% enriched UO_2 particles, embedded in radiation-stabilized polyethylene moderator. This reactor was especially suitable for the tests. The dose rate was low and reduced the accelerated test effect. The parameters measured before, during, and after irradiation of the SCR's were anode voltage prior to and after conduction, anode-to-cathode current after conduction, gate voltage, current to initiate conduction, and anode stud temperature. Two 2N1843 silicon-controlled rectifiers under derated electrical load were irradiated to 4.3×10^{13} nvt (≥2.9 Mev) and a gamma dose of 300,000 rad over a ten-hr period. The electrical characteristics changed under a fast-neutron dose of ~10^9 n/cm^2-sec. Measurements taken 12 hr following irradiation showed no change from those taken immediately following the irradiation. The change in one SCR was shown as a monotonic increase with dose, but in the other SCR both parameters showed smaller total change except for a steeper rise between the sixth and the eighth hr. The conducting impedance changes in both specimens were in similar fashion. Since only two units were tested, no statistically significant conclusion is made regarding the behavior of this type of SCR. (BBB)

ISOTOPE TECHNOLOGY

General

42775 RECENT DEVELOPMENTS IN THE PRODUCTION OF LOW-ENERGY GAMMA OR X-RAY EMITTERS. Case, F. N.; Pressly, R. S. 9p. (CONF-641017-11). Gmelin, AED-CONF-64-221-14.

From Symposium on Low Energy X and Gamma Sources and Applications, Chicago.

The design of radioactive sources as directed toward obtaining maximum output of low-energy gamma and Bremsstrahlung radiation is described. The methods of fabrication, encapsulation, and the measurement of the energy of the radiation from the sources are discussed. A summary is given of the new radioisotopes which are presently being investigated and their availability. (auth)

Industrial Applications

Refer also to abstracts 42537 and 42667.

42776 (AECL-2264) THE CANADIAN DESIGN APPROACH TO MEDICAL PRODUCT STERILIZATION PLANTS. Brown, M. G. (Atomic Energy of Canada Ltd., Ottawa (Ontario). Commercial Products Div.). June 1965. 19p. (CONF-650439-1). Dep.; AECL $0.50 cy.

From Conference on Radiation Sterilization of Medical Supplies and Pharmaceuticals, Stockholm.

Several aspects of radiosterilization plants discussed are: existing and presently planned sterilizing plants; information required by the plant designer; and utilization of information in devising design concepts. Illustrations of some specific Atomic Energy of Canada Limited plants are presented, and design and construction of the plants are discussed. (H.G.D.)

42777 (NEIC-RR-14) RADIOISOTOPES IN INDUSTRY. Second National Symposium on Technical Use of Radioisotopes, Spala, October 16-19, 1963. Summaries. (Nuclear Energy Information Center, Warsaw (Poland)). 1965. 24p. Dep. mn.

Review papers presented at the Second National Symposium on Technical Uses of Radioisotopes are summarized in English and Russian. (M.C.G.)

42778 (TID-22001) THE EFFECT OF GAMMA RAYS ON HADDOCK AND CLAMS INOCULATED WITH CLOSTRIDIUM BOTULINUM, TYPE E. Monthly Progress Letter, April 1-April 30, 1965. (Massachusetts Inst. of Tech., Cambridge. Dept. of Nutrition and Food Science). Contract AT(30-1)-3325. 12p. Dep. mn; CFSTI, $1.00 cy, $0.50 mn.

Results are reported from tests to determine the time for development of toxicity in haddock fillets inoculated with type E Clostridium botulinum spores and stored at 45°F with an without radiation processing. The data showed that samples irradiated with 100,000 rad and inoculated at a level of 1×10^6 spores per gram became toxic in the same time as unirradiated samples. Samples inoculated with 1×10^4 spores per gram and stored at 45°F without irradiation treatment became toxic in 16 days while similar samples exposed to 100,000 or 200,000 rod γ radiation became toxic in 19 days. Data are included on the thermal destruction times for type E, C. botulinum toxin. The data show that toxin in haddock fillets was destroyed by temperatures obtained during deep fat frying. It is concluded that low-dose radiation processing of fish fillets to be refrigerated at temperatures above freezing presents no particular public health hazard of botulism. (C.H.)

42779 (TID-22126) THE EFFECT OF GAMMA RAYS ON HADDOCK AND CLAMS INOCULATED WITH CLOSTRIDIUM BOTULINUM, TYPE E. Monthly Progress Letter, July 1-31, 1965. (Massachusetts Inst. of Tech., Cambridge. Dept. of Nutrition and Food Science). Contract AT(30-1)-3325. 10p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Results are presented from tests on commercial haddock fillets to determine the presence of type E, Cl. botulinum. Eight of the 10 samples of 555 grams each did not contain this organism. The other 2 samples each contained approximately one type E cell or spore per 100 grams of fillets. The results of tests to determine outgrowth and toxin development in irradiation-sterilized ground haddock inoculated with type E, Cl. botulinum alone or with this organism together with another bacterium and incubated aerobically and anaerobically at 44°F are listed. The only samples which became toxic were those inoculated with type E, Cl. botulinum alone and incubated anaerobically; those inoculated with type E, Cl. botulinum together with Pseudomonas fragi and incubated aerobically; and those inoculated with type E, Cl. botulinum together with Pseudomonas fluorescens and incubated aerobically. Tests for toxin were made on irradiation-sterilized haddock samples inoculated with only one of the following test organisms and incubated aerobically and anaerobically at 45°F: S. lactis, S. faecalis, L. viridescens, Cl. sporogenes, P. fragi, and P. fluorescens. None of these cultures were toxic. (C. H.)

42780 IRRADIATION PRESERVATION OF PACIFIC COAST FISH AND SHELLFISH. III. STORAGE LIFE OF PETRALE SOLE FILLETS AT 33 deg AND 42 deg F. Spinelli, J.; Eklund, M.; Stoll, N.; Miyauchi, D. (Bureau of Commercial Fisheries, Seattle). Food Technol., 19: 126-30(June 1965).

The fillets were packed in enameled cans and sealed either under vacuum or in air. Irradiation was conducted at 0. 0.2, 0.3, 0.4, 0.5, and 0.6 Mrad of ^{60}Co γ rays. Immediately after being irradiated, the samples and controls were stored at 33 and 42°F. The irradiated product was sampled at weekly intervals, and unirradiated control samples at 2- to 3-day intervals. When vacuum-packed fillets were irradiated between 0.2 and 0.3 Mrad, storage life of the fillets was extended 3 to 5 times at 33°F, with only a minimum change in flavor and odor. However, induced flavor and odor changes were apparent when 0.3 Mrad was exceeded and irradiating in air at all dose levels yielded a product that became rancid after about 10 days' storage. Accordingly, all subsequent studies were vacuum-packed, irradiated at 0.2 and 0.3 Mrad, and stored at 33 and 42°F. Irradiation at either 0.2 or 0.3 Mrad killed 95 to 99% of the bacteria originally present in the fillets. The time required for the bacteria to regain their original numbers was greater in the 0.3-Mrad sample. Although some yeast and mold survived irradiation, their eventual contribution to sensory changes in the vacuum-packed fillets are nil. Yeast and mold counts never exceeded 600 per g in any of the irradiated samples. Total volatile bases (TVB), trimethylamine (TMA), and volatile acid numbers (VAN) were determined on both irradiated and unirradiated fillets to find how these indices compared when incipient spoilage was reached. TVB values of 10 to 12 mg/100 g of nitrogen were reached when the fillets were at borderline acceptability. Values of over 15 correlated with spoilage. In control samples, TVB values of 20 indicated incipient spoilage, and values of 30 correlated with spoilage. TMA values did not correlate with sensory scores. The production of TMA in the irradiated fillets was so greatly reduced that it was not used as a criterion of quality. VAN values of 30 or over correlated with spoilage. About the same range of VAN correlated with spoilage in both irradiated and unirradiated fillets. Thus VAN and TVB change sufficiently during storage to make them useful indices of product quality, but TMA does not significantly increase during storage. Autolysis occurred during storage of irradiated fillets stored at 33°F in the relative absence of bacterial growth. (BBB)

42781 AUTUMN TRANSPLANTATION OF X-IRRADIATED KITCHEN ONION (ALLIUM CEPA L.). Srb, Vladimir; Vosoust, Jan (Karlova Universita, Hradec Kralove, Czechoslovakia). Genet. Slechteni, 1: 47-56 (1965). (In Czech).

The influence of autumn transplantation was studied on Vsetaty variety onion seedlings irradiated with doses of 100, 200, 500, and 1000 R of x rays with regard to the rooting and wintering of the plants, as well as on their growth and development in the following year. Vsetaty seedlings, usually transplanted in spring, are also suitable for autumn transplantation for an early harvest during the period when there are no fresh onions on the market. Irradiation of the seedlings with doses of 100 and 250 R stimulated autumn root system formation. The rooting, and consequently also the wintering, is improved. The best growth and development during the spring season (until the harvest) was observed in the plants from seedlings irradiated with 100 R. The average weight of the harvested onions was 23% higher than that of the onions from the nonirradiated control seedlings; they also had a 19% larger diameter as compared with the controls. The other doses applied (250 and 500 R) inhibited growth of the onions; the dose of 1000 R was lethal for the Vsetaty variety. A dose of 100 R of x radiation contributes to the harvest of good quality early onions as early as in the second half of June of the following year. (BBB)

42782 THE EFFECT OF X IRRADIATION ON THE STORAGE OF SEEDLINGS OF KITCHEN ONION (ALLIUM CEPA L.). **Srb, Vladimir (Karlova Universita, Hradec Kralove, Czechoslovakia). Genet. Slechteni, 1: 65-79 (1965). (In Czech).**

The effect of x irradiation (100, 1000, 10,000 R) on the storage of onion seedlings was studied. Losses in fresh weight, dry matter, and water content, condition of the stored onions (drying out, budding, decay, diseases) and changes in cell permeability served as criteria. The measurements were carried out once a month for eight months. Storage of onion seedlings was favorably influenced by all doses of irradiation used (as evaluated at the end of the experiment), the storage in paper bags being more suitable than free storage in dishes. For radiation retardation of rot the dose of 10,000 R proved to be the best for all measurements during the eight-months storage experiment with irradiated onions. In the onions from plants treated with this dose, the losses in weight at the end of the experiment were 22% (seedlings stored free in dishes) and 47% (seedlings stored in paper bags) lower as compared with the respective controls. When evaluated from the point of view of irradiated onion seedlings stored during the winter for spring planting, the dose of 100 R proved to be the most suitable. At the end of March (time for spring planting), after a five-month storage, it gave the highest percentage of healthy onions. Cell permeability of the epidermis in the stored onions was substantially influenced by x irradiation; there were practically no differences between the doses used in change of cell permeability. The high radiosensitivity of the Vsetaty variety of Allium cepa was noted. (BBB)

42783 CALCULATION OF DOSE DISTRIBUTION IN A GRAIN γ STERILIZER AND DETERMINATION OF ITS BASIC PARAMETERS BY LINE PRODUCTION METHOD OF DISINSECTIZATION. **Andreev, S. V.; Martens, B. K. Radiobiologiya, 5: 605-11(1965). (In Russian)**

A gamma de-infesting unit (^{60}Co and ^{137}Cs) for irradiating wheat as it moves continuously along the core of the irradiator has considerable advantages over the current method of grain irradiation in containers. Elimination of the necessity of loading and unloading the containers makes the process more efficient and the close approach of the wheat to the source permits use of smaller sources. A simplified method was developed for calculations on the equipment. (tr-auth)

42784 FLUORESCENT X-RAY ANALYZER WITH RADIOACTIVE SOURCES FOR MIXING CONTROL OF CEMENT RAW MATERIALS. **Imamura, Hiroshi; Uchida, Kaoru; Tominaga, Hiroshi (Ube Industries, Ltd., Japan). Radioisotopes (Tokyo), 14: 286-92(July 1965).**

An industrial fluorescent x-ray analyzer with radioactive sources for rapid analysis of lime, silica, alumina, and ferric oxide in cement raw mix samples was completed for mixing control of raw materials. The analyzer is characterized by the combined use of alpha-ray source and soft x-ray source, the vacuum-sealed measuring head made to be sample-changeable without air inflow, the non-dispersive simultaneous determination of elements with a stabilized pulse height spectrometer, and the spectrometer circuits are all transistorized. Further, in the determination, fused glassy samples are used, and the calculation to deal with the matrix effect is carried out by a process control electronic computer. The determination is expected to be more accurate than the usual fluorescent x-ray analysis. The use of the analyzer is considered to be favorable, for it is simple in principle, easy in practice, speedy in measurement, and economical. (auth)

42785 A STUDY OF RADIOACTIVE SOURCES USING POROUS GLASS. **Tsukui, Kazushige (Tokyo Shibaura Electric Co., Ltd.). Radioisotopes (Tokyo), 14: 382-9 (Sept. 1965). (In Japanese).**

Radioactive sources were developed by using porous glass. Porous glass (SiO_2 96%, B_2O_3 4%, void space 20%) and radioactive materials (^{137}Cs, ^{60}Co, ^{90}Sr, ^{204}Tl) were used. The procedure consists of three steps. First, a piece of sample (about 5mmϕ × 15mm) of porous glass was dipped for 5 ~ 24 hrs in radioactive material solution of various concentrations. Second, the sample which has absorbed radioactive materials was washed in water. Then, the absorbed moisture was removed completely by gentle heating in a warm place. Third, the sample glass was shrunk at about 1,000°C for 10 hrs. At this step, the glass radioactive source became a kind of sealed source, which depended on the fact that the porosity of glass surface was lost by heat treatment. The relation between radioactive concentration of the radioisotope (^{137}Cs, ^{60}Co, ^{90}Sr, ^{204}Tl) solution and the absorbed radioactivity in glass was investigated in detail. In this case, when the radioactive concentration of radioisotope in hydrochloric, nitric, or sulfuric acid solution increased, the absorbed quantities of radioactive material per one gram of porous glass increased. The concentration of acid in radioisotope solution was found to have an effect on the absorption of radioactive material for the porous glass. Also, the amounts of radiation absorption depend only on the volume of glass. Lastly, it was found that when the glass that absorbed radioactive material was shrunk at a high temperature, the glass radioactive sources were stable chemically and physically and in boiling test the release of radioactive material was almost negligible. The shrinkage of porous glass by heat treatment was about 13v%. (P.C.H.)

42786 RADIATION PASTEURIZATION OF FOODS. **Machurek, Joseph E. (Atomic Energy Commission, Washington, D. C.). Res. Develop. Associates Activities Rept., 16: 52-5(1964).**

Summaries of work done by the Division of Isotopes Development of the USAEC toward developing radiopasteurization of selected products to the point of technical and economic feasibility and developing prototype commercial radiation facilities are presented. Radiopasteurization was shown to extend the refrigerated shelf life of marine products for thirty days or more, permitting an expansion of fresh fish markets to areas presently inaccessible. Shrimp and haddock have successfully undergone consumer feeding tests in cooperation with the Department of the Army at Ft. Lee, Virginia. The shelf life of very perishable fruits such as California strawberries was extended by a week or more. Results in general can be said to be quite promising, the Clostridium botulinum problem in fish remaining one of the few contradictory areas. Data are tabulated on irradiators including the following types: research, mobile, on-ship, bulk grain, the marine products development irradiator, and the Hawaiian irradiator. The Food and Drug Administration (FDA) has approved petitions for radiopasteurization of bacon, wheat, and wheat products. Petitions are pending on potatoes, oranges, and packaging materials for low dose use, and petitions are scheduled for submission for FDA approval on peaches, nectarines, onions, carrots, apricots, cherries, and several marine products. Future plans of the food irradiation program are discussed. (H.G.D.)

42787 WHOLESOMENESS, BIOCHEMICAL AND MICROBIOLOGICAL ASPECTS OF THE AEC RADIATION PASTEURIZATION OF FOODS PROGRAM. Whitehair, L. A.; Anderson, D. L. (Atomic Energy Commission, Washington, D. C.). Res. Develop. Associates Activities Rept., 16: 56-62(1964).

The USAEC's Division of Biology and Medicine supports studies in the areas of wholesomeness, microbiology, biochemistry and physiology of low-dose irradiated foods. Two-year (chronic toxicity) animal feeding studies on irradiated soft-shell clams and short-term protein availability studies on irradiated haddock, flounder, crab and shrimp are in progress (University of Illinois). The protein availability data will essentially complete the required wholesomeness data for haddock, crab, flounder and shrimp. Longterm animal feeding studies on irradiated strawberries will also be conducted (Industrial Bio-Test Laboratories, Inc.). Foods for these wholesomeness studies are being irradiated at the Natick Laboratories facility. Two studies on growth and toxin production of various strains of Clostridium botulinum, Type E, in various substrates and media as well as in marine product homogenates are in progress (University of Michigan and Continental Can Co., Inc.) The natural incidence of Cl. botulinum, Type E, spores in Pacific coastal sea mud, crab gut, and flounder is also being determined (Bureau of Commercial Fisheries). The possibility of toxin formation in irradiated and Type E spore-inoculated haddock fillets and soft-shell clams under various temperature and storage periods is being investigated (MIT). Microbiological and biochemical studies on irradiated fish are being conducted at the University of Washington. Efforts are concentrated on the bacteriological safety of irradiated sea foods. Biochemical studies are designed to identify products and mechanisms involved in tissue changes and relate them to radiation dose levels. Basic studies on radiation biochemistry of fruit and fruit pathogens are being conducted at the University of California. Biochemical and physiological changes in irradiated fresh fruits and vegetable tissues are being studied at Cornell University. Quantitative techniques are being developed to identify the chemical components involved in flavor and odor changes which may occur in fish due to irradiation and prolonged refrigerator storage by the Bureau of Commercial Fisheries. A study on the biochemical alterations in the protein moiety of hemoproteins (fish myoglobin) as a result of ionizing radiation is being conducted at the University of California. The studies described were initiated to provide vital data concerning the wholesomeness and biological safety, microbiology and biochemistry of low-dose irradiated foods. The findings in these studies will be consolidated with data from the Army Radiation Sterilization of Foods Program wherever applicable, and with the results of studies supported by the Division of Isotopes Development for inclusion in petitions for clearance to the Food and Drug Administration. (auth)

42788 HEALING OF IRRADIATED AND NONIRRADIATED HETEROTRANSPLANTS IN SPONDYLODESIS AFTER HALSTEAD-SAMOV. Parizek, Jan (Charles Univ., Hradec Kralove, Czechoslovakai). Sb. Ved. Prac. Lekar. Fak. Karlovy Univ. (Hradec Kralove), 6: Suppl., 391-3 (1963). (In Czech).

A comparison was made of the use of irradiated and nonirradiated bone grafts to effect bony union of vertebrae in the Halstead-Samov surgical procedure (spondylodesis). In this procedure autogenous, homogenous, and heterogenous bone grafts may be used. Autotransplants are the best material but for many reasons, preserved heterotransplants may be required, although these are antigenic. The effectiveness of irradiation of heterografts with 1000 R in reducing their antigenicity was investigated. Thirteen heterografts in the form of halved calf ribs were irradiated with this dose applied to the cut surface of the spongiosa and compared with 13 nonirradiated heterografts. They had been used one and two years previously in spondylodesis. In general, no essential differences were found between the healing of the irradiated grafts and the nonirradiated ones as seen in x-ray pictures. It was observed, however, that heterogenous material is less suitable for this kind of operation on the spine, where it is used for the most part heterotopically. When the grafts were placed into a firm bone bed anywhere else in the skeleton, good results were obtained. (BBB)

Power Application

42789 (DP-984) RADIATION PROPERTIES OF ^{238}Pu PRODUCED FOR ISOTOPIC POWER GENERATORS. Stoddard, Dean H.; Albenesius, Edward L. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). July 1965. Contract AT(07-2)-1. 21p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

The alpha, gamma, and neutron radiations associated with $^{238}PuO_2$ produced on a large scale at the Savannah River Plant are presented for evaluation by users of this material as a heat source in isotopic power generators. (auth)

42790 (N64-32021) ALPHA-CELL DIRECT-CONVERSION GENERATOR. Plummer, A. M.; Gallagher, W. J.; Matthews, R. G.; Anno, J. N. (Battelle Memorial Inst., Columbus, Ohio). Aug. 19, 1964. Contract NAS 3-2797. 68p. (NASA-CR-54162). CFSTI $3.00 cy, $0.75 mn.

Eight chapters are presented on the theory of alpha-cell operation. Four chapters on experimental studies with an alpha-cell direct-conversion generator and summaries of work performed to date and work to be performed in the future are included. (auth)

42791 (SC-DR-65-205) RFD-2 TELEMETRY SYSTEM. Keck, L. J. (Sandia Corp., Albuquerque, N. Mex.). July 1965. Contract AT(29-1)-789. 96p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

The description of the design and performance of the telemetry system flown on Re-entry Flight Demonstration No. 2, which was the second in Sandia's series of operational safety flight tests of systems for nuclear auxiliary power is presented. (auth)

42792 HYDROGEN-HYDRIDE CELL. Crouthamel, Carl E.; Heinrich, Robert R. (to U. S. Atomic Energy Commission). U. S. Patent 3,208,883. Sept. 28, 1965.

A fuel cell of the hydrogen-hydride type is designed having a metal anode, a fused salt electrolyte and a hydrogen-diffusing cathode, and including an alpha source located on the gas side of the hydrogen-diffusing cathode. (AEC)

Separation and Production

See also CHEMISTRY — Separation Processes and Procedures.

42793 (CEA-Bib-56) SEPARATION PHOTOCHIMIQUE DES ISOTOPES. (Photochemical Isotope Separation). Rozenberg, Jean (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). May 1965. 14p. Dep. mn.

The principle and the physico-chemical conditions of isotope separation using photo-chemical reactions are examined. The experimental attempts made up to the present have led to variable results. The present report is concerned more particularly with mercury, chlorine, uranium, and hydrogen. The isotopic separation of mercury is sufficiently well developed, after numerous studies, for mention to be made of an industrial application. The possibility of extending the use of the photo-chemical separation method to other elements such as lithium is discussed. Finally the application of a photo-thermal process to uranium isotope separation is mentioned. This literature survey covers the period 1920–1964 and includes 38 references. (auth)

42794 (K-OA-1360) A PHENOMENOLOGICAL THEORY OF THE SWEEP DIFFUSION COLUMN FOR ISOTOPE

SEPARATION (thesis). Hoglund, Richard LeRoy (Oak Ridge Gaseous Diffusion Plant, Tenn.). Aug. 1965. Contract W-7405-eng-26. 221p. Dep. mn; CFSTI $6.00 cy, $1.25 mn.

Submitted to Univ. of Tennessee, Knoxville.

If a binary mixture of gases is allowed to diffuse in a current of an auxiliary gas or vapor, a separation of the process gas mixture can be obtained which is a function of the difference between the diffusion coefficients of the components of the process gas relative to the auxiliary vapor. This method of separating mixtures is called either sweep or mass diffusion. These processes can be carried out either in discrete stages or in continuous columns. A theoretical study of the sweep diffusion column process is presented. A phenomenological theory for the continuous countercurrent flow column sweep diffusion process for the separation of close cut mixtures such as isotopes is developed. General expressions are derived for the separation parameters including the stage length, stage separation factor, and column upflow rate. The separation parameters can be evaluated numerically once a model for the axial flow velocity profile is assumed. A velocity profile model which includes the effects of the transverse temperature gradient, the falling film velocity, and the difference in molecular weights between the sweep vapor and process gas is described and compared with simpler models. Expressions for the maximum theoretical separative capacity of a sweep diffusion column and for the form of the optimum flow profile are derived. Exact and approximate treatments of the separative capacity loss resulting from appreciable process gas solubility are presented. The separative capacity loss associated with the axial flow taper in a column is treated. The phenomenological column theory is used to obtain a process design for a cascade of sweep diffusion columns for the production of 100 grams per day of methane enriched to 0.90 mole fraction in carbon-13. The optimum operating condition for columns one meter in length and nominally two inches in diameter using steam as the sweep vapor was found to be two atmospheres absolute total pressure and a wall spacing of 0.4 cm. A total of 1812 such columns would be required to form the cascade. (auth)

42795 ^{244}Cm PRODUCTION AND SEPARATION—STATUS OF THE PILOT PRODUCTION PROGRAM AT SAVANNAH RIVER. Groh, Harold J.; Huntoon, Richard T.; Schlea, Carl S.; Smith, James A.; Springer, Fred H. (E. I. du Pont de Nemours and Co., Aiken, S. C.). Nucl. Appl., 1: 327-36(Aug. 1965). (TID-21458).

At Savannah River, ^{244}Cm is being produced from ^{239}Pu in reactor irradiations designed for successive neutron captures. A separations process, which was successfully piloted, isolates curium from intermediates (plutonium isotopes and ^{243}Am) and fission products. The 2.65-w of heat generated per gram of curium in the product can be used in isotopic power sources. (auth)

42796 SEPARATION OF LITHIUM ISOTOPES BY COUNTERCURRENT-EXCHANGE-ELECTROLYSIS (thesis). Arkenbout, Gerardus Johannes. Utrecht, Rijksuniversiteit Utrecht, 1965. 70p.

Studies were made of lithium isotope separation by countercurrent-exchange electrolysis. Attempts were made to solve problems concerning the dispersion of the amalgam in the exchange column and realization of the reflux reactions. A suitable packed column was developed; sand with a particle size between 0.35 and 0.5 mm was used as the packing material. When all the interstices in the packing were filled with mercury before starting the countercurrent, the channeling in the column was reduced to an acceptable extent. A continuous reflux procedure was developed based on exchange electrolysis with dimethyl formamide solutions containing sodium bromide or strontium chloride. The reduction of the lithium ions was achieved by electrolyzing lithium chloride in an aqueous solution using a cathode of flowing mercury. Ten experiments, each lasting 20 to 40 hr, were carried out using a column 1 to 2 m. At the bottom of the column an increase of ^{6}Li content from 7.5 to 13% was obtained. The decrease in ^{6}Li at the top of the column changed the content from 7.5 to 5.3% ^{6}Li. A way of making the cathodic reflux procedure continuous by using a solvent different from dimethyl formamide was found. (M.C.G.)

42797 DIFFUSION SEPARATION OF FLUIDS. Simon, Franz Eugen; Fuchs, Klaus; Peierls, Rudolf Ernst (to U. S. Atomic Energy Commission). U. S. Patent 3,208,197. Sept. 28, 1965.

A method is presented for the treatment of mixtures of fluids so that the mixture is separated into two fractions of different composition. A particular field of application is the diffusion separation of gaseous or vaporous media by means of porous membranes. The mixtures of fluids are treated by providing a cascade of stages operating in series which is subdivided into a number of sub-cascades within each of which one fraction from each stage except the last is passed forward to a succeeding stage and one fraction from each stage except the first is passed backward to a preceding stage. The whole or part of the corresponding fractions from the last and first stages of a sub-cascade are respectively led forward to a succeeding sub-cascade and back to a preceding sub-cascade, except in the case of the first and last sub-cascades, the corresponding fractions from which constitute the final output fractions. (AEC)

MATHEMATICS AND COMPUTERS

Refer also to abstract 43063.

42798 (LA-3355) A SIMPLE METHOD FOR FINDING THE ZEROS OF POLYNOMIALS, BASED ON D'ALEMBERT'S LEMMA. Motteler, Zane C. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). July 15, 1965. Contract W-7405-eng-36. 24p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

A method is described for approximating the roots of a polynomial equation on an electronic digital computer. The method is based on d'Alembert's Lemma of algebra, which states that the absolute value of a polynomial assumes a minimum if and only if it is zero. Comparison of the method with other techniques for solving polynomial equations leads to the conclusion that, in addition to simplicity, the method offers timing and accuracy quite comparable to those of other methods coded with the same precision and sophistication. (auth)

42799 THE SIEMENS-SCHUCKERT R AND D COMPUTER CENTRE AND ITS WORK. Anke, Klaus; Nuding, Erich. Siemens-Z., 39: 537-40(May 1965). (In German).

The activities and equipment of the Siemens-Schuckert center are briefly described. Activities associated with reactor development are considered in detail. (D.C.W.)

METALS, CERAMICS, AND OTHER MATERIALS

General

Refer also to abstract 43529.

42800 (AD-617733) EVALUATION OF RMSRP TUNGSTEN SHEET. Final Report, September 1963-July 1965. St. Germain, F. (Solar, San Diego, Calif.). July 9, 1965. Contract NOw 63-0786d. 182p. (ER-1399-6).

An experimental program was conducted to evaluate various gages of RMSRP tungsten sheet developed under the sponsorship of the Bureau of Naval Weapons for the Refractory Metal Sheet Rolling Program. The objectives of this study on tungsten sheet was to determine metallurgical uniformity and mechanical properties; establish formability limits and optimum forming temperatures; fabricate and test structural elements; and fabricate a typical aerospace subassembly component. Tensile property data for several gages of material encompassing the temperature range from ambient to 3000°F are presented. Confidence limits on the elevated temperature mechanical properties for tungsten are also included. Results of the compression test evaluations up to 1800°F for 0.060- and 0.100-inch sheet are also presented. Five joining techniques for tungsten were investigated and of the five, diffusion bonding and mechanical joining showed the most promising. Tensile and bond shear strength data for ambient and elevated temperature joint evaluation tests are reported and discussed. An investigation was conducted to determine the formability characteristics of RMSRP tungsten sheet in the area of predicting and developing forming limits and establishing optimum forming temperatures for several conventional processes. Formability limits were established for brake form, dimpling, corrugating, joggling, and deep draw forming processes. Theoretical formability limit graphs were experimentally established for optimum forming temperatures and part geometry. The formability behavior of RMSRP tungsten for each of the forming processes is discussed. Structural element bend test panels were fabricated from thin gage RMSRP tungsten sheet. Attempts were made to join the panels by diffusion bonding and mechanical joining (riveting). Diffusion bonding proved to be the only successful method. Mechanical joining was unsuccessful due to extensive panel cracking. Several typical panel configurations were bend tested at elevated temperatures. Bend test data are presented encompassing the temperatures of 1000 through 2500°F. Bend test results indicated that the structural panel elements were comparable with the predicted analytical limits established from base material and joint strength properties for the panel configurations. Results on the fabrication of typical aerospace subassembly components are discussed. (auth)

42801 (BMI-1721(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING MARCH 1965. Dayton, Russell W.; Paprocki, Stan J. (Battelle Memorial Inst., Columbus, Ohio). Apr. 1, 1965. Contract W-7405-eng-92. 46p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Research and development progress is reported on reactor materials and components, fuel materials and coatings, radioisotope and radiation applications, and materials for gas cooled reactors. (J.R.D.)

42802 (CEA-R-2767) SUR L'URANIUM DE ZONE FLOTTANTE (theses). (Of Floating-Zone Uranium (thesis)). Clottes, Georges (Commissariat a l'Energie Atomique, Fontenay-Aux-Roses (France). Centre d'Etudes Nucleaires). 1965. 112p. Dep. mn.

Submitted to Paris Univ., France.

The floating zone method was chosen in order to purify uranium. The various parameters of this method were studied theoretically and technologically. The most efficient speed is 0.7 cm/hr, the direction can be only upwards, and the fusion must take place under pressure of 10^{-7} torr or so. The study of the floating zone stability led to a definition of a field touching the size and diameter of uranium drops, which, on the one hand coincides with Heywang's conditions and, on the other hand, is compatible with a fusion in the core of the bar. Such field shows that the floating zone can easily apply to bars whose diameter is included between 5 and 10 mm, and that it cannot work out when the diameter exceeds 21 mm. The apparatus, with a means of heating by electronic bombardment under ultra-vacuum, is conditioned by the various parameters that have been studied. As the analysis results were insufficient, the uranium was characterized by metallurgical and physical tests: micrographical tests, microhardness, and electric resistivity at low temperature, showed a definite purification at the bar head; these results were confirmed by the lowering at 270°C of the recrystallization temperature together with the definite tendency of the refined metal to polygonize. The electric resistivity measurements constitute an easy and quantitative way of figuring out the metal purity. The influence of an impurity on the electric resistivity of uranium was studied with U-Au alloys with a weak concentration of gold. Two important points were brought out: (1)-The measurement of electric resistivity should be performed on bars annealed in γ phase and cooled. (2)-Gold has a very strong influence on uranium; the value 500 $\mu\Omega$cm per cent of gold resulted in a total concentration of 20 to 30 ppm of soluble impurities in the refined metal. (D.L.C.)

42803 (EURAEC-1397) [MECHANICAL PROPERTIES OF STEELS]. Quarterly Report No. 2, January-April 1965. (Compagnie des Ateliers et Forges de la Loire, Paris (France). Departement des Recherches). Contract 033-64-9 TEEF (RD). 43p. (EUR-2356). Dep. mn; CFSTI $2.00 cy, $0.75 mn.

Work Performed Under United States-Euratom Joint Research and Development Program.

The mechanical properties at room temperature, the stress-corrosion in 42% $MgCl_2$ solutions, and the stress-corrosion in $MgCl_2$-NaCl solutions as a function of pH were measured. The addition of silicon to the austenitic and austeno-ferritic steels increased the yield strengths and the stress-corrosion resistance to boiling $MgCl_2$. (W.L.G.)

42804 (GEAP-3771-16) HIGH PERFORMANCE UO_2 PROGRAM. Quarterly Progress Report No. 16, January-March 1965. Lyons, M. F. (ed). (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Apr. 15, 1965. Contract AT(04-3)-189. 89p. (EURAEC-1418). Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Work Performed Under United States-Euratom Joint Research and Development Program.

In performance tests of UO_2 fuel it was found that spacer wear on the EX-12A assembly fuel rods during the final five cycles of irradiation was slight. A large volume of gas was extracted from one of the 20,000 Mwd/te burnup powder fuel rods indicating an internal pressure at room temperature of 500 psi. The fission gas release in the EX-12A rods appears to be greater than 70% of theoretical and N_2 in the powder fuel appears to have been released. A massive metallic inclusion found at the bottom of the fuel column in the powder rod, corresponding to a Ru spike in the gamma scan, has the highest specific activity (>50,000 R/min) of any sample handled in the RML. The lattice parameters of the Zircaloy-2 in the vicinity of the pinhole failure in Rod 12C were found to be significantly expanded relative to normal Zircaloy-2. The failure location in Rod 12DV could not be located and appears to have been lost during sample preparation. The first direct measurement of the thermal conductivity of vibratory compacted powder was performed. The results indicate a significantly lower conductivity than for pellet fuel. Transient excursions to lower thermal conductivity values for UO_2 occurred during initial rise to full-power test operation. The thermal con-

ductivity of UO_2 pellets with enlarged equiaxed grains was measured directly and shown to be identical to normal-grain-size UO_2 pellets. The irradiation of the first isothermal fission gas release capsule was started. The capsule operated very satisfactorily and verified design predictions. Kr retention in melted and resolidified UO_2 was less than 5×10^{-6} cm^3/g after the UO_2 was heat treated for 15 min at 2900°C under Kr at 16 kg/cm^2. There was no detectable change in the lattice parameters of UO_2 after holding it at 2900°C for 4 hours in a closed W capsule. The W content of this sample was approximately 5000 ppm after heat treatment. Isothermal annealing of vibratory compacted arc-fused UO_2 at 1900°C for 30 and 504 hours, and in a temperature gradient for 30 hours, did not significantly alter the UO_2 appearance from the as-vibrated condition. The boundary between molten and solid UO_2 was demonstrated to be between the high density, pore free zone and the zone with residual porosity by using W markers and short heating times. A new heating assembly for Re gas bulb temperature sensor calibration was itself accurately calibrated against the melting points of metals. Corrosion of Zr and Zircaloy-2 was studied in a purified I_2 atmosphere. Both the pitting attack and the stress-corrosion cracking that was previously reported were also shown to occur in a purified I_2 atmosphere. The morphology of pits in Zircaloy-2 can be affected by the nature of the surface film (presumably an oxide of Zr) and by cracks in the film. The reaction rate of I_2 with Zr is linear, indicating the absence of a passivating layer of reaction product or I_2 impurity component. The reaction rate with Zr varies with temperature and with pressure according to the equation $dx/dt = kp^{0.4}$. (J.R.D.)

42805 (NAA-SR-10621) THE PROPERTIES AND IRRADIATION BEHAVIOR OF U_3Si_2. Shimizu, H. (Atomics International, Canoga Park, Calif.). July 25, 1965. Contract AT-11-1-GEN-8. 46p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

A limited study of the compound U_3Si_2 was made in reference to its use as a prospective nuclear fuel in sodium cooled reactors. Pertinent physical and chemical data for the U–Si system were compiled or obtained and are reported. Special emphasis was directed to the irradiation study of fusion cast compositions that were somewhat deficient in Si in the range of 7.08 to 7.17 wt % Si (cf. 7.30 wt % Si for U_3Si_2). A 12-in. fuel column consisting of six each 10%-enriched U_3Si_2 specimens, sodium bonded to a stainless steel cladding, was irradiated to an average burnup level of approximately 0.65% of the total uranium. The maximum average operating fuel center-line and surface temperatures were 1750 and 1290°F, respectively. Except for the top specimen, which was cracked into several pieces, the irradiated fuel slugs were in relatively good condition. Fractional fission gas release of approximately 2.6% and representative density decreases of 6 to 7% were measured. The stainless steel cladding was intact and its microstructure appeared unaffected. (auth)

42806 (NLCO-955) SUMMARY TECHNICAL REPORT FOR THE PERIOD APRIL 1, 1965–JUNE 30, 1965. Burgett, R.; Thomas, B. J. (eds.) (National Lead Co. of Ohio, Cincinnati). Aug. 11, 1965. Contract AT(30-1)-1156. 71p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Abstracts are presented for the seven sections of the report. (W.L.G.)

For abstracts of individual sections see: 42420–42422, 42824–42826, and 42851.

42807 (PG-Inf.Ser.-10) THE PURIFICATION OF SODIUM FROM OXYGEN AND MONITORING OF THE OXYGEN CONTENT IN SODIUM. Subbotin, V. I.; Kirilov, P. L.; Kozlov, F. A. Translated by J. G. Lomaz (U.K.A.E.A. Production Group, Capenhurst, Eng.) from U.S.S.R. report No. 701. 16p. Dep.; CFSTI $1.00 cy, $0.50 mn; JCL $1.60 fs, $0.80 mf.

The problems attendant to the presence of oxygen in sodium as a heat transfer medium are considered. The characteristics of cold traps and hot traps (gettering agents) for sodium purification are discussed. Finally, instruments for monitoring oxygen in sodium are described. (D.L.C.)

42808 EVALUATION OF STAINLESS STEEL CASTING ALLOYS FOR CRYOGENIC SERVICE IN THE 80-INCH LIQUID-HYDROGEN BUBBLE CHAMBER. Goodzeit, C. L. (Brookhaven National Lab., Upton, N. Y.). Advan. Cryog. Eng., 10: 26-36(1965).

An investigation of the magnetic properties, mechanical properties, and weldability of some alloys proposed for use in the chamber body of the 80-in. liquid-hydrogen bubble chamber is summarized. (D.C.W.)

42809 EMBRITTLEMENT OF A NIOBIUM–ZIRCONIUM ALLOY WITH 25 PER CENT Zr BY CONTAMINATION DURING VACUUM TREATMENTS. Josso, E.; Palmier-Gerber, M. Mem. Sci. Rev. Met., 62: 479-84(June 1965). (In French).

Embrittlement results from contamination by back-diffusion of organic vapors of the exhaust system. Cracking of these vapors frees the carbon which combines with the zirconium to produce ZrC. Using the liquid nitrogen trap which lowers the pressure to 1×10^{-6} mm Hg greatly reduces the chemical change but does not eliminate it. (auth)

42810 DIFFUSION OF OXYGEN IN NIOBIUM. Litman, A. P. (Oak Ridge National Lab., Tenn.). Phys. Status Solidi, 11: K47-8(Sept. 1, 1965).

The diffusivity of oxygen in polycrystalline niobium was determined at 600 and 815°C. The results are in reasonable agreement with values obtained from microhardness measurements. (D.C.W.)

42811 X-RAY DIFFRACTION FROM DEFORMED CERIUM: EFFECTS DUE TO EXTRINSIC STACKING FAULTS. Otte, H. M.; Chessin, H. (Martin Co., Orlando, Fla.; State Univ. of New York, Albany). Phys. Status Solidi, 11: 91-100(Sept. 1, 1965).

Preliminary measurements of the peak shifts in the x-ray powder pattern of cerium cold-worked by filing at room temperature are reported. Because cerium oxidizes rapidly in the atmosphere, the experimental procedure is more complicated than that usually followed in the preparation of cold-worked metal filings for the measurement of intrinsic faults. The preliminary data on cold-worked cerium, although of lower accuracy than that normally attainable in this type of work, nevertheless showed peak displacements in the Debye-Scherrer pattern that were in most cases in the direction theoretically predicted for relatively low probabilities of extrinsic stacking faults. A more detailed investigation is required to verify the line broadening and asymmetry effects produced in the line profiles. The observations were complicated by an apparent annealing out of the peak shifts at room temperature although the increased (extrapolated) lattice parameter remained. (auth)

42812 INVESTIGATING MATERIALS WITH RADIOCHEMICAL METHODS. Gebauhr, Werner. Siemens-Z., 39: 449-53(May 1965). (In German).

After a brief introduction to the elementary processes of radiochemistry, a brief description is given of the application of the radioindicator method and activation analyses in problems connected with the production of semiconductors. By means of radioautography, it is also possible to indicate the local distribution of impurities, etc. (auth)

42813 ZIRCONIUM AND ITS ALLOYS AS SPECIAL MATERIALS FOR WATER-COOLED NUCLEAR REACTORS. Roesler, Ulrich. Siemens-Z., 39: 552-8(May 1965). (In German).

The properties of zirconium and zirconium alloys for use in water-cooled reactors, particularly pressurized-water reactors, are discussed. It is noted that alloys with a base of Nb–Zr appear to be particularly promising for use at temperatures above 350°C. (D.C.W.)

42814 DISTILLATION OF YTTRIUM. Vorobiov, V. V. (Khar'kov State Univ.). Ukr. Fiz. Zh., 10: 786-92(July 1965). (In Ukrainian).

Investigations were conducted to ascertain the further possibilities of utilizing vacuum distillation for obtaining yttrium of a high degree of purity by using a condensation column with a temperature gradient. The temperature drop on the column was 300 to 350°C. Evaporation was carried out from the liquid phase. Yttrium was obtained with a purity of 99.8% by weight. (auth)

42815 FORMATION AND QUENCHING OF NITRIC OXIDE IN A CONTINUOUS FLOW FURNACE. Thompson, A. L. (McGill Univ., Montreal). 11p. (CONF-650444-3). Gmelin, AED-CONF-65-119-2.

From Western States Combustion Inst., 1965 Spring Meeting, Hollywood, Calif.

A pre-pilot plant facility for the thermal fixation of atmospheric nitrogen was successfully built and operated. Gas temperatures exceeding 3000°K were reached but the quenching rates available to fix the nitric oxide were found to be inadequate for the gases at these high temperatures. However, yields of 3.7% nitric oxide by volume were realized experimentally. A separate water cooled sampling probe inserted at the top of the furnace gave quenching rates of the order of 10^6 °C/sec. This also permitted the study of the effect of variation in the quenching rate while maintaining other conditions constant. The oxygen concentration appeared to have less effect than previous results indicated, but this may have been due to uncertainties in estimating gas temperatures near 3000°K. Some ideas for future developments are proposed. (P.C.H.)

Corrosion

Refer also to abstracts 43034 and 43603.

42816 (WCAP-3725) CORROSION AND CORROSION PRODUCT BEHAVIOR IN CHEMICAL SHIM SOLUTIONS. Whyte, D. D.; Taylor, G. R. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Dec. 1964. Contract AT(30-1)-3269. 54p. Dep. mn; CFSTI $3.00 cy, $0.50 mn.

Metal release rates from type 304 stainless steel exposed to high temperature boric acid and partially neutralized boric acid solutions were determined in a recirculating loop system by radiotracer techniques. Results indicate that initially the release rate is higher in the partially neutralized solution but that the rate decreases rapidly with exposure time. The net deposition rate on type 304 stainless steel was also determined for both chemistries with the rate being higher in the partially neutralized boric acid solution. The net deposition rate on various reactor structural materials and on preoxidized specimens of these materials is also included. Analyses of the ion-exchange resins used for both tests are included showing that the main action of the resins is ion-exchange and not filtering. (auth)

42817 THE OXIDATION MECHANISM OF PURE URANIUM IN CARBON DIOXIDE BETWEEN 350 deg AND 650 deg C. Stobbs, J. J. (Central Electricity Generating Board, Berkeley, Gloucestershire, Eng.). J. Electrochem. Soc., 112: 916-21(Sept. 1965).

Weight gain/time curves obtained on a thermobalance were related to metallographic observations of the oxide. It was found that the oxide was initially protective, but as a result of nonuniform oxidation and cracking the oxidation rate accelerated until finally a linear rate law was obeyed. In the early stages of oxidation a separate layer of oxide grew at the oxide gas interface, but soon attained a limiting thickness of a few thousand Angstroms and did not influence the over-all oxidation behavior. Carbon monoxide formed from the reaction between uranium and carbon dioxide reacted further in the cracks in the oxide. (auth)

42818 THE OXIDATION AND MECHANICAL PERFORMANCE OF TUNGSTEN AT HIGH TEMPERATURES AND HIGH PRESSURES. Etemad, G. A.; Holly, D. E. (Martin Co., Orlando, Fla.). New York, American Inst. of Aeronautics and Astronautics, 1965, Preprint No. 65-293, 16p., $1.00. (CONF-650711-45). ORINS.

From AIAA 2nd Annual Meeting and Technical Demonstration, San Francisco.

The application of tungsten to hypersonic flight environments appears attractive where structural strength and thermal protection are required. However, the design must consider the oxidative removal of material and the degradation of mechanical properties at high temperatures. A study was made in which tungsten and several composite tungsten systems were exposed to heat fluxes from 1015 to 4160 Btu/ft^2 sec at stagnation pressures from 21 to 70 atm and at stagnation temperatures from 5500 to 6750°R. The test was conducted in the Cornell Aeronautical Laboratory wave superheater facility, where thirty-nine specimens were tested. The variation of surface recession rate with heat transfer coefficient was determined. Test results showed that in environments and structures where heat transfer coefficients are less than 1.5 lb/ft^2 sec and surface temperatures do not exceed 4000°R, the material is stable, except for oxidation which proceeds in a rate-controlled manner. As the surface temperature rose above 4000°R, at heat transfer coefficients up to 2.6 lb/ft^2 sec and at stagnation pressures below 50 atm, surface recession occurred by diffusion-controlled oxidation. When stagnation pressures exceeded 50 atm, structural failure of the material occurred at the surface, and very high recession rates up to 0.1 in./sec were observed. (auth)

Fabrication

42819 (DF65SL-205) MEASUREMENT OF RESIDUAL STRESSES IN HEAVY WELDMENTS. Juhl, P. B. (General Electric Co., Schenectady, N. Y. Materials and Processes Lab.). May 8, 1965. NObs-88601. 76p.

For Knolls Atomic Power Lab., Schenectady, N. Y.

Methods were developed to install bonded electrical strain gages deep in a previously welded test block and then to free the residual welding stresses in such a manner that the resultant strain gage readings could be interpreted as a measure of the residual stress pattern. These methods were employed on a test block of ASTM A302B alloy steel to obtain quantitative information in both the as-welded condition and again after thermal stress-relieving. The residual stress pattern in each condition is calculated and these are compared to determine the effectiveness of the stress-relieving procedure. The degree of stress-relief is compared to that obtained in constant-strain relaxation tests of bolt-type specimens of the same material. (auth)

42820 (EURAEC-1252) STUDY OF JOINTS WELDED IN VERY THICK STEEL PLATES. Quarterly Report No. 1, July 1-September 30, 1964. (Institut de Soudure, Paris (France)). Dec. 2, 1964. Contract 007-64-TEEF(RD). 14p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Work Performed under United States-Euratom Joint Research and Development Program.

Twenty 1300 × 450 × 130 mm Super Elso steel plates were tested and fifteen accepted. The instrumentation of thick Mn-Mo steel plates with thermocouples for studying welding thermal cycles was developed. The chamfering of thick plates with the oxyacetylene blowpipe was studied, and the cooling times were determined for thickness of 20 to 200 mm. It was found that the martensitic transformation is less likely to occur in the heat-affected zone in the thicker plates. (D.L.C.)

42821 (EURAEC-1377) FABRICATION OF UO_2 POWDERS OF HIGH BULK DENSITY BY MELTING AND GRINDING AND THEIR PROCESSING INTO FUEL ELEMENTS. Quarterly Report No. 19, January 1-March 31, 1965. Duerrschnabel, W.; Liebmann, B.; Mueller, N.; Neumann, O.; Saller, H.; Schikarski, L. (Nuklear-Chemie und -Metallurgie G.m.b.H., Wolfgang am Main (West Germany)). Contract 013-63-7 TEED. 26p. (EUR-2352). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Work Performed Under United States-Euratom Joint Research and Development Program.

The quantity of UO_2 powder melted per charge was in-

creased by lengthening the crucible and using higher bulk density powders. About one-half of the UO_2 reguli melted under H_2 contained substoichiometric material with U metal inclusions. Tests on the effects of the steel tube dimensions on the density of the vibratory and swage compacted UO_2 powder revealed a dependence on wall thickness and a lesser dependence on the diameter. Evacuation for 15 hrs pumping time at room temperature of vibratory-compacted UO_2 reduced the water content from 25 to 13 ppm. A separation of coarse and fine particles during compacting gave a nonuniform water distribution within the tubes. Swaging the stainless steel tubes to a 19% cross section reduction caused some damage to the inside surface of the tube due to the coarse UO_2 particles. These impressions, which were detectable by eddy current tests, were up to about 16 μm in depth. More pronounced damage also occurred. (W.L.G.)

42822 (EURAEC-1401) STUDY OF THE APPLICATION OF THE VERTICAL WELDING PROCESS UNDER ELECTRO-CONDUCTING SLAG ON THICK STEEL PLATES IN SHOP OR FIELD CONDITIONS. Special Report No. 7. (Chantiers de l'Atlantique Penhoet-Loire, Paris (France)). Mar. 9, 1963. Contract 054-61-12-RDF. 30p. (EUR-2360). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Work Performed under United States-Euratom Joint Research and Development Program.

Apparatus for recording the current and voltage used and the position during the vertical welding of thick steel plates by a A 372P Paton machine (Russian manufacture) are described. (W.L.G.)

42823 (MRI-158,21) DRILLING OF BERYLLIUM SHEET MATERIAL. Final Report. Conrath, Carl A. (Lockheed Missiles and Space Co., Sunnyvale, Calif.). Dec. 1963. 43p.

Data were obtained on the drilling of Be sheet material with a Tornetic drilling machine. Acceptable holes were obtained when a 0.191-in. dia burr-point drill was used on 0.074-in. gage metal. (D.L.C.)

42824 (NLCO-955, pp 5.1-16) DEVELOPMENT OF PROCEDURES FOR CASTING NPR BILLETS. Lusky, R. J. (National Lead Co. of Ohio, Cincinnati).

Techniques were developed to directly cast sound NPR billets for subsequent co-extrusion with Zircaloy cladding. Single-billet and multiple-billet casting techniques were developed. Three sound NPR billets with good chemical homogeneity can be simultaneously produced in the multiple mold assembly described. (auth)

42825 (NLCO-955, pp 6.1-9) URANIUM ROLLING TEST: CROSS-SECTIONAL SHAPES AND DEFORMATIONS PRODUCED BY THE SIX-STAND CONTINUOUS MILL. Hesselbrock, H. W. (National Lead Co. of Ohio, Cincinnati).

The cross sections obtained in the production rolling of $1\frac{1}{2}$-inch uranium rods from $2\frac{1}{16}$-inch by $2\frac{9}{16}$-inch oval billets were determined for each stand of a six-strand continuous mill. The changes in shape were measured, and the reductions in area and deformation rates were calculated. The resulting data are reported, and the effect on grain structure of the work performed by the successive mill stands is described. (auth)

42826 (NLCO-955, pp 7.1-7) SHEARING URANIUM RODS TO FUEL CORE BLANKS. Stephens, W. E. (National Lead Co. of Ohio, Cincinnati).

Rolled uranium rods were successfully sheared to core blank lengths and machined to finished core dimensions. The grain structures near the ends of the blanks were disturbed by shearing; however, after beta heat treatment, the structures were indistinguishable from those of standard production cores which had been cut to lengths in a machining operation. (auth)

42827 REFRACTORY METALS CAN BE PLATED AND ELECTROFORMED. West, Philip. Mater. Design Eng., 62: No. 1, 93-4(July 1965).

Refractory metals can be electroplated over conventional metals or electroformed into parts by means of a high-temperature fused salt process. A molten refractory metal fluoride is dissolved in an alkali fluoride and the mixture is electrolyzed with sufficient cathode current for deposition. The coatings can be applied in thicknesses from 0.0004 in. to at least 0.25 in. Refractory metal shapes can be produced by plating the metal over a removable mandrel or mold. Applications of refractory metal electroplates and electroforms are discussed. (M.C.G.)

42828 PREPARATION OF HARD AND HIGH-MELTING TRANSITION METAL CARBIDES FROM AUXILIARY METAL BATHS. Kieffer, R.; Rassaerts, H.; Schob, O. (Technische Hochschule, Vienna). Monatsh. Chem., 96: 685-94(1965). (In German).

The carburizing of the transition metals of the IVa-VIa group of the periodic system with the help of an auxiliary metal bath represents a simple rapidly working process for the production of carbides high in bound carbon and with a low content of oxygen and nitrogen. Prefabricated carbides can easily be reprecipitated and purified. Oxygen and nitrogen contents are lowered to about a tenth of the original values. The most suitable auxiliary metals are cobalt and a 70/30 Fe-Ni alloy. Besides WC, TaC, NbC, and TiC the carbides ZrC, HfC, VC, Mo_2C, and $(Cr,Co)_7C_3$ were produced. (auth)

42829 PREPARATION OF PuC PELLETS BY VACUUM SINTERING. Kruger, O. L. (Argonne National Lab., Ill.). Nucl. Appl., 1: 348-55(Aug. 1965).

Plutonium monocarbide pellets of 93% theoretical density were pressed and sintered from powder that was prepared by crushing arc-melted buttons. Powders with particle sizes of <74, <44, and <15 μm had optimum sintering temperatures of 1400, 1350, and 1250°C, respectively. Additions of up to 4 wt % binder to the powders caused a decrease in the densities and an increase in the carbon contents of the sintered pellets. Metallographic and x-ray diffraction examination and chemical analysis were used to determine some phase relationships in compositions near the monocarbide composition in the Pu-C-O ternary system. (auth)

42830 POWDER MAGNESIUM AND MAGNESIUM-BERYLLIUM ALLOYS. Ivanov, V. E.; Zelenskii, V. F.; Fayfer, S. I.; Zhdanov, S. M.; Maksimenko, V. I.; Savchenko, V. I. Porosh. Met. Akad. Nauk Ukr. SSR, No. 5, 46-53 (1965).

Powder Mg-MgO alloys containing 0.3 to 10% MgO and super heat-resistant Mg-Be alloys containing 1 to 10% Be were developed. Mg alloys were prepared by cold compacting the powder mixture into bars, 65 × 150 mm. The compacted bars were then hot extruded at 500 to 520°C with 98 to 99% reduction. A mixture of oil with laminated graphite was used for lubrication during hot extrusion. MgO improved the strength of Mg alloys, and its effectiveness increased with increasing temperature. Addition of MgO also improved the structural stability and mechanical properties of Mg-Be alloys. The addition of Be increased resistance to high-temperature oxidation and reduced the sensitivity to overheating. The properties of Mg-Be alloys excelled those of Mg alloys. Powder Mg-Be alloys were used for shielding U fuel elements in reactors and were tested successfully for 6000 hr at 500 to 520°C and a neutron flux of 2.10^{20} n/cm². (CFSTI)

42831 PRODUCTION OF ALUMINIDES OF REFRACTORY METALS. Sinel'nikova, V. S. Porosh. Met. Akad. Nauk Ukr. SSR; No. 6, 10-17(1965).

Experiments were conducted to find the best method of producing aluminides of refractory metals. 99.99%-pure Al, 99.99%-pure Mo and Nb and iodide Ti and Zr, 99.2%-pure V, and 99.4%-pure Ta were used in making aluminides by melting. High-purity aluminides with a composition close to the stoichiometric were obtained by induction or arc melting with a nonconsumable electrode in an Ar atmosphere. Sound solid specimens of high-purity aluminides can be obtained by grinding arc- or induction-melted ingots and subsequent hot compacting. Synthesizing by the powder-metallurgy method was best for producing aluminides of refractory metals where high purity is not required. Green

specimens were compacted in an Ar atmosphere at 600°C for 3 to 5 min, after which the temperature was raised to the required sintering temperature. The optimum temperatures (°C) for compacting aluminides under pressure were: VAl_{11} 660 to 680, VAl_6 720 to 730, VAl_3 ~1200, V_5Al_8 ~1500, $NbAl_3$ ~1600, Nb_2Al 1740 to 1870, $TaAl_3$ ~1400, $HfAl_3$ ~1260, Mo_3Al ~1600, $ZrAl_3$ ~1470, $ZrAl_2$ ~1520, Zr_3Al_2 ~1420. (CFSTI)

42832 FABRICATION STUDY OF URANIUM NITRIDE FUEL. Kasamatsu, T. Sumitomo Elec. Tech. Rev., No. 5, 88-93(Jan. 1965).

The fabrication of uranium mononitride by sintering was studied. Metallic uranium was used as the raw material and the relation among the reacting temperature, time, atmosphere and the quality of formed UN and its composition was investigated. Then the relation among the sintering temperature, sintering atmosphere, density of the sintered UN pellet, porosity, and composition was studied by using UN powder that was made from metallic U. The sintered UN pellet had a 93% theoretical density when it was sintered in N_2. The density was higher in vacuum and lower in argon. The pellet was light grey in external appearance and UN monophase in composition. (TCO)

42833 CONTROLLING WELD DISTORTION BY ELECTRON BEAM TECHNIQUES. Baugh, E. D. (Westinghouse Electric Corp., Cheswick, Pa). New York, American Society of Mechanical Engineers, 1965, Preprint No. 65-MD-14, 5p. $1.00. (CONF-650546-1). ORINS.

From American Society of Mechanical Engineers, Design Engineering Conference and Show, New York.

Welding distortion is often the cause of high costs in manufacturing. The low distortion associated with electron-beam welding prompted designers to take another look at weld distortion. Some of the basic factors contributing to weld distortion are discussed to provide a better understanding of how the electron-beam welder minimizes this problem. (auth)

42834 PRODUCTION OF URANIUM OXIDE BODIES. Lloyd, Henry; Williams, Neville Ronald; Wheatley, Christopher Cameron Hope (to United Kingdom Atomic Energy Authority). U. S. Patent 3,194,852. July 13, 1965. Priority date June 22, 1959, Great Britain.

A method is described for producing bodies of both stoichiometric (ratio of oxygen atoms to uranium atoms is substantially 2, but less than 2.05) and non-stoichiometric (ratio of oxygen atoms to uranium atoms lies between 2.05 and 2.33) uranium oxide suitable for use as fuel material in reactors. For producing a non-stoichiometric body suitable for sintering to yield a high density UO_2 body, a mixture of stoichiometric or non-stoichiometric UO_2 powder and an organic binder is cold compacted and then heated to a temperature of 200 to 250°C in an oxidizing atmosphere until the ratio of oxygen to uranium atoms in the mixture is raised to at least 2.33. Such bodies may then be sintered in an inert atmosphere at a temperature of 1300 to 1500°C to yield dense bodies of non-stoichiometric UO_2. They may subsequently be heated to a temperature above 1000°C in a reducing atmosphere to yield dense bodies of stoichiometric UO_2. Alternatively, the bodies may be sintered directly in hydrogen at a temperature of at least 1500°C to yield dense bodies of stoichiometric UO_2 in a single step. (B.L.M.)

42835 CARBIDE COATINGS FOR GRAPHITE. Criss, Filmore F. (to U. S. Atomic Energy Commission). U. S. Patent 3,208,870. Sept. 28, 1965.

A method of forming a protective carbide coating on a graphite surface is described, using niobium or tantalum carbide as the coating. The oxide in powdered form of the desired metal coating is mixed with an organic filler such as collodion or lacquer thereby forming a paint. The surface of the graphite is coated with the oxide paint and then heated in a furnace having an inert atmosphere to a reducing temperature of about 2300°C. (AEC)

42836 CARBIDE COATINGS ON GRAPHITE. Criss, Filmore F.; Wohlberg, Cornel (to U. S. Atomic Energy Commission). U. S. Patent 3,208,872. Sept. 28, 1965.

A method is given for coating the inside surface of a graphite tube with a metal carbide by decomposing Nb_2O_5, Ta_2O_5, or V_2O_5 inside the tube. The tube is passed through a furnace at a constant speed, the furnace being of a sufficient size that the front of the tube is still in the hot region when the rear opening enters the hot region. (AEC)

Properties and Structure

Refer also to abstract 43506.

42837 (AD-610234) AN INVESTIGATION OF DIFFUSION IN THE COLUMBIUM-VANADIUM SYSTEM (thesis). Geiss, Robert Charles (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering). Aug. 1962. 112p. (GA/Mech./62-2). CFSTI $4.00 cy, $0.75 mn.

Diffusion rates in the Nb–V system were investigated using electron microprobe analysis of the diffusion zones to determine concentration gradients. The interdiffusion coefficient, D, was found using a computer program to solve the Matano-Boltzmann method. Activation energies, Q, and frequency factors, D_0, were derived from values of D at the same concentrations but at different temperatures. Movement of W Kirkendall markers at 12.7 at. % Nb and 1404°C during the diffusion anneal indicated $D_V > D_{Nb}$. Diffusion in the Nb–V system is apparently by a vacancy mechanism. (auth)

42838 (AECL-2271) ETCHANTS FOR INCONEL ALLOYS X-750 AND 600. Lloyd, G. C. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). June 1965. 22p. Dep., AECL $0.50.

The characteristics and relative effectiveness of the known etchants of Inconel Alloys X-750 and 600 were investigated. The etchants studied, both chemical and electrolytic, were for both optical and electron microscopy. The characteristics of the etchants are listed and the recommended etchants for each group are given. Photomicrographs of typical structures etched with the recommended etchants are included. (auth)

42839 (AERE-R-4873) SOME MEASUREMENTS OF THE DAMPING CHARACTERISTICS OF URANIUM AND URANIUM CARBIDE FUEL PINS. Crawley, H. J.; Parsons, M. J. (Atomic Energy Research Establishment, Harwell (England)). May 1965. 16p. Dep.

A limited series of damping measurements was made on uranium metal and uranium carbide, with and without stainless steel cladding, for temperatures up to 750°C. Young's Modulus was also calculated. (auth)

42840 (ANL-6960) KATHAROMETRIC AND RESISTIVITY STUDIES OF PuO_{2-x} EQUILIBRIA. Atlas, Leon M.; Schlehman, Gilbert J. (Argonne National Lab., Ill.). Mar. 1965. Contract W-31-109-eng-38. 25p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

The variation of electrical resistivity (ρ) and x with oxygen pressure was measured for PuO_{2-x} at 1100 and 1400°C. The procedures, which are described in detail, include (a) equilibrating a ceramic in a once-through stream of H_2-H_2O-He mixture, (b) reoxidizing the specimen to $PuO_{2.00}$ in a fixed volume of helium–oxygen mixture, and (c) analyzing the oxygen content with a thermal-conductivity gas detector. Some data for TiO_{2-x} at 1200 and 1300°C were also obtained to check the gas-analysis method. Experimental results for PuO_{2-x} are presented as plots of log x vs log $p(O_2)$, log ρ vs log $p(O_2)$, and ΔG_O^0 (the relative partial molar free energy of oxygen in the solid) vs log x. The log-log plots of x and ρ against $p(O_2)$ are linear over a wide range of x, and at both 1100 and 1400°C, the composition lines have steeper slopes than the resistivity lines. A mass-action analysis is presented that relates the slope difference to a variation of the activity coefficient of Pu^{+3} ions with the concentration of defects. At 1100°C, these defects are thought to be primarily quadruply dissociated interstitial plutonium atoms. (auth)

42841 (CEA-R-2763) ETUDE DES TRANSFORMATIONS $\gamma \rightarrow \beta$ ET $\gamma \rightarrow \alpha$ DANS LES ALLIAGES URANIUM–

MOLYBDENE DE FAIBLES TENEURS. (Study of $\gamma \rightarrow \beta$ and $\gamma \rightarrow \alpha$ Transformations in Uranium–Molybdenum Alloys of Low Molybdenum Content). Lefranc, Jacqueline (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). May 1965. 60p. Dep. mn.

The distance between the curves at the beginning and at the end of the $\gamma \rightarrow \beta$ transformation gets progressively smaller as the transformation temperature increases. A delay in the transformation was observed when the alloys have undergone a homogenizing treatment (950°C) which leads to a large-grain γ structure. (auth)

42842 (CONF-650804–6) THE LIQUID DENSITIES OF CERIUM AND NEODYMIUM METALS. Rohr, William G. (Mound Lab., Miamisburg, Ohio). Mar. 1965. Contract AT(33-1)-Gen-53. 9p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From 5th Rare Earth Research Conference, Ames, Iowa.

The density of liquid neodymium and additional data on the density of liquid cerium were determined by a vacuum pycnometric method as a function of temperature. For neodymium, liquid density measurements made from near its melting point to 1231°C exhibited a temperature dependence expressed as: $\rho = [7.373 - (5.28 \times 10^{-4})(°K)] \pm 0.019$ g/cc. Liquid cerium density measurements were extended to 1173°C. The combined cerium data yielded a temperature dependence which could be expressed as: $\rho = [6.930 - (2.27 \times 10^{-4})(°K)] \pm 0.027$ g/cc. (auth)

42843 (COO–359-10) DIFFUSION IN LIQUIDS AND SOLIDS. Technical Progress Report, November 1, 1963–August 31, 1964. Grace, Richard E. (Purdue Univ., Lafayette, Ind. School of Metallurgical Engineering). Sept. 1, 1964. Contract AT(11-1)-359. 26p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Progress on research problems in the broad area of diffusion in metals, metal oxides, and surface reactions at gas/metal oxide interfaces is summarized. Diffusion in ternary Cu–Mn–Zn solid solutions, migration of point defects in $SrTiO_3$, oxidation-reduction reactions of Fe, and FeO in damp H_2 were investigated. Each of the projects is a thesis investigation of a graduate student. (J.R.D.)

42844 (COO–1198-283) MICROSTRAIN STUDY OF STRAIN HARDENING IN COPPER. Bilello, John Charles (Illinois Univ., Urbana. Dept. of Mining, Metallurgy, and Petroleum Engineering; Illinois Univ., Urbana. Materials Research Lab.). Aug. 1965. Contract AT(11-1)-1198. 91p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Microstrain parameters in the various stages of deformation were determined for polycrystals and single crystals of copper. They are compared with the predictions of various work hardening theories. (D.L.C.)

42845 (COO-1477-1) DEVELOPMENT OF TEST PROCEDURES. FRACTURE TOUGHNESS OF REACTOR PRESSURE VESSEL STEELS. Progress Report, May 1, 1965–July 31, 1965. Ripling, E. J.; Crosley, Phillip (Materials Research Lab., Inc., Richton Park, Ill.) Aug. 13, 1965. Contract AT(11-1)-1477. 5p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Small fracture mechanics specimens were developed for determining plane strain toughness. Two sample shapes were considered, both involving a taper to correct for the change in compliance with crack length. In the first sample the load is transmitted through the test member and in the second by means of external attachments. For the second testing procedure essentially all of the metal will be used for crack propagation. (auth)

42846 (EURAEC–1399) STUDY OF THE APPLICATION OF THE VERTICAL WELDING PROCESS UNDER ELECTRO-CONDUCTING SLAG ON THICK STEEL PLATES IN SHOP OR FIELD CONDITIONS. Special Report No. 5. (Chantiers de l'Atlantique Penhoet-Loire, Paris (France)). Nov. 15, 1962. Contract 054-61-12-RDF. 86p. (EUR-2358). Dep. mn; CFSTI $3.00 cy; $0.75 mn.

Work Performed Under United States–Euratom Joint Research and Development Program.

The chemical composition, hardness, impact strength, microstructure, and tensile properties were determined as a function of sample position in a 200 mm thick Mn–Mo steel plate. (W.L.G.)

42847 (LA-DC-6529) SOME OBSERVATIONS CONCERNING THE MAXIMUM IN THE LATTICE PARAMETER VS COMPOSITION CURVE OF THE GROUP 4A CARBIDES. Storms, Edmund K. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1964]. Contract W-7405-eng-36. 9p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Recent reports of a maximum in the lattice parameter vs composition curves of TiC and ZrC are supported by this study. There is also an indication that this behavior is shared by HfC as well. A comparison between the x-ray and pycnometer density places an upper limit to the metal-vacancy concentration at 5 ± 3 per 1000 metal atoms. In view of this small concentration, it is concluded that the maximum is not due to the presence of such vacancies in the lattice. (auth)

42848 (LA-DC-6565) HEAT CAPACITIES OF $NbC_{0.775}$, $NbC_{0.825}$, $NbC_{0.980}$ AND Nb_2C BELOW 320 deg K. Sandenaw, Thomas A.; Storms, Edmund K. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1964]. Contract W-7405-eng-36. 21p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

The heat capacities of the niobium carbides were measured between 7°K and 320°K using an adiabatic calorimeter. (auth)

42849 (MLM–1262) REACTOR FUELS AND MATERIALS DEVELOPMENT PLUTONIUM RESEARCH: JANUARY–MARCH 1965. Wittenberg, L. J.; Grove, G. R. (Mound Lab., Miamisburg, Ohio). Mar. 31, 1965. Contract AT-33-1-GEN-53. 14p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

The phase equilibria in the Pu–Ce–Fe system were investigated. Tie lines for the $CeFe_2$–$PuFe_2$ solid solution were established; a nonequilibrium liquid was detected below the minimum solidus temperature of the system; and an increase in the transformation temperature of hexagonal beta cerium from –10 to 397°C resulted from the addition of as little as 2 at.% Fe. Initial investigations of the two ternary systems, Pu–Y–Gd and Pu–Y–Nd, indicate that the maximum solid solubility is between 20 and 30 at.% Pu in each system. The measured density of liquid Nd decreased from 6.670 g/cc at 1035°C to 6.583 at 1231°C. The investigation of the relationship between viscosity and composition in the liquid Pu–Ce alloy system was continued. A maximum in the viscosity versus composition plot occurs at 5 at.% Ce. Construction details are given for the new high-temperature calorimeter designed for high precision heat capacity measurements of plutonium-bearing materials from ambient temperature to approximately 900°C. Examination of particles of UO_2 that were melted in an Ar–He gas mixture in the induction-coupled plasma torch revealed small inclusions that were tentatively identified as U metal. (auth)

42850 (NASA-TN-D-2989) EFFECT OF VARIATIONS IN SILICON AND IRON CONTENT ON EMBRITTLEMENT OF A COBALT-BASE ALLOY (L-605). Sandrock, Gary D.; Ashbrook, Richard L.; Freche, John C. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Sept. 1965. 24p. CFSTI $1.00 cy, $0.50 mn.

An investigation was conducted to study the effect of variations in silicon and iron content in L-605 (HS-25) on room-temperature ductility and other mechanical properties after aging at 1600°F for various times up to 1000 hours. The silicon content of the alloy was investigated over a range from 0.12 to 1.00 percent, and the iron content over a range from 0.16 to 3.24 percent. These ranges are generally within the manufacturer's specified nominal composition limits for these elements. This investigation shows that for low silicon content heats (0.12 to 0.23 percent) the room-temperature ductility of L-605 sheet aged for 1000 hours at 1600°F was improved over that of the high silicon content heats (0.49 to 1.00 percent), as measured by tensile elongations. The former heats had elongations of 13 to 16 percent, the latter had elongations of

2 to 6 percent. Little apparent effect on room-temperature ductility after aging was observed as a result of the variation of iron content from 0.16 to 3.24 percent. Aging at 1600°F reduced the room-temperature ultimate tensile strength of L-605 for all the compositions investigated, and no overall relation between silicon content and ultimate tensile strength after aging was observed. Low iron content heats generally had higher ultimate tensile strengths after aging for 1000 hours than did the high iron content heats. Hardness generally increased with aging time for all the heats, although this effect was less pronounced for the low silicon heats. Upon aging, precipitates formed preferentially at grain and twin boundaries as well as randomly in the matrix. The lower silicon content heats had a lesser amount of precipitate after aging than did the high silicon content heats. Variations in iron content appeared to have little overall effect on microstructure after aging. (auth)

42851 (NLCO–955, pp 4.1-7) STUDIES OF PRECIPITATION IN URANIUM–UAl_2 ALLOYS BY ELECTRON MICROSCOPY. Althaus, W. A. (National Lead Co. of Ohio, Cincinnati).

As-cast and heat-treated uranium-base alloys containing less than 1000 ppm aluminum were studied by electron microscopy. The study shows a mode of precipitation of UAl_2 in uranium. (auth)

42852 (TID–21226) APPLICATION OF ONSAGER'S VARIATIONAL PRINCIPLE TO STEADY STATE PHASE TRANSFORMATIONS. Li, Che-yu; Weart, H. W. (Cornell Univ., Ithaca, N. Y. Dept. of Engineering Physics and Materials Science). [1963]. Contract AT(30-1)-2558. 33p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Steady state transformations of the eutectic and eutectoid type are studied by direct application of Onsager's variational principle with careful attention to the use of constraints corresponding to the experimental conditions. Assumption of linear relations between fluxes and forces limits the analysis to steady states close to equilibrium. It is also assumed that: (1) Mass transfer and formation of interface between product phases are the only dissipative processes, (2) a constant fraction of available free energy is used to drive mass transfer, and (3) dissipative processes do not interact. For eutectics, the analysis predicts the following relation between scale of the transformation product, s, and velocity, v: s^2v = constant. Recent experimental data confirms the functional form of the relation and gives satisfactory quantitative agreement with a reasonable estimate of the constant. For eutectoids, inadequate data prevents a conclusive test of the predicted relation between s and the amount of undercooling, ΔT: $s\Delta T$ = constant. Comparison of this analysis with others shows that steady state criteria used previously, such as maximum velocity and maximum decrease of free energy, are compatible with Onsager's principles under certain conditions. (auth)

42853 (TID–21229) REDISTRIBUTION OF ATOMS DURING EUTECTIC SOLIDIFICATION. Weart, H. W. (Cornell Univ., Ithaca, N. Y. Dept. of Engineering Physics and Materials Science). [1964]. Contract AT(30-1)-2558. 44p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Three aspects of eutectic solidification were subjected to experimental test. First, by zone melting, the k-value of Cd in Cd–Sn and Cd–Zn was found to lie between 0.99 and 1.01, and between 0.98 and 1.02, respectively. This result is taken to indicate that it is unlikely that there can be sufficient build-up of major components in the eutectic liquid to generate the constitutional supercooling needed to cause the formation of cells. It is suggested, however, that small changes in composition of the eutectic liquid may give rise to the faults observed in lamellar eutectic structures. Secondly, from measurement of the k-value of ^{204}Tl in Cd–Zn eutectic and from microautoradiography of the solid, it is concluded that considerably more Tl impurity is incorporated into the eutectic solid than would be predicted by assuming the overall k-value of the composite interface to be an average of the k-values of the individual phases, weighted by their fractional areas on the cross section. Such an assumption predicts an overall k of 9×10^{-3}, but the measured value is 0.28. Details of the autoradiographic technique which is capable of resolutions of the order of 1 micron are given. Finally, additional evidence is obtained in support of the spacing-velocity relation s^2v = constant, predicted by several theories. The relative insensitivity of the value of the constant to the alloy system is taken to mean that, on a unit volume basis, all such diffusion-controlled transformations occurring close to equilibrium store about the same amount of energy in interfaces in the product per amount of energy used to carry out the transformation. (auth)

42854 (TIM–810) THE VAPOR PRESSURE OF POTASSIUM BETWEEN 1065 AND 1500K. Rigney, D. V.; Kapelner, S. M.; Cleary, R. E. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). June 1965. Contract AT(30-1)-2789. 27p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

The vapor pressure of potassium was determined from 1065 to 1500°K. The results of a regression analysis of the data are given by the equation $\log_{10} P\ (atm) = 4.94758 - 0.22226 \log_{10} T - 4421.94\ T^{-1}(°K)$. The enthalpy of vaporization and the enthalpy of the saturated vapor for potassium were calculated over the temperature range of these experiments. (auth)

42855 (AERE-Trans–1027) LATTICE CONSTANT DETERMINATION WITH X-RAY GONIOMETERS TAKING INTO ACCOUNT HIGH-TEMPERATURE TECHNIQUES. Ebel, H. Translated by J. B. Sykes (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Z. Angew. Phys., 16: 490-8(1964). 27p. Dep.; JCL $2.60 fs, $1.01 mf.

In lattice constant measurement with recording x-ray goniometers, several effects give rise to systematic errors. The errors, if known numerically, can conveniently be taken into account in the Bragg angle. The unknown errors of eccentricity and zero-point can be eliminated in cubic crystals by extrapolation with cot θ. In general, the extrapolation does not give straight lines. From the form of the extrapolation curve, ΔR and $\Delta 2\theta$ can be deduced. The result of the extrapolation is finally treated to remove the refraction error. This type of evaluation restricts the lattice-constant error as far as possible to the statistical error and under suitable conditions offers the possibility of restricting the measurement to a single reflection at high or low temperatures. (auth)

42856 (UCRL-Trans-1223(L)) THE CRYSTAL STRUCTURE AND THE STRUCTURAL RELATIONSHIP BETWEEN THE δ- AND γ-PHASES IN THE COPPER–TIN SYSTEM. Knodler, H. Translated by Z. St.-Galley (Univ. of California Lawrence Radiation Lab., Livermore) from Metall, 18: 1172-7(1964). 28p. Dep. mn; JCL $2.60 fs, $1.04 mf.

Samples containing 20.51 at.% Sn, quenched to room temperature from the γ-region (700°C) and the δ-region (500°C), had the stable δ-phase structure. Individual δ-phase crystals about a cm^3 size, quenched from the γ-region, were shown by Laue photographs to be monocrystals of homogeneous orientation, while corresponding photomicrographs indicated that they were subdivided into transition zones. The number of atoms of the unit cell in the δ-phase was found to be 416, indicating that the δ-phase is derived directly from the ordered, high-temperature γ-phase by nondiffusive transformation. A lattice model was constructed for the arrangement of atoms in the δ-phase in accordance with the relation found between the high-temperature γ-phase and the position of the atoms in Cu_5Zn_8. The diffraction angles and the intensities were calculated for 108 lines of the Debye-Scherrer diagram. Experimental and calculated values were in satisfactory agreement. Due to the structural relation between the γ- and the δ-phases, an ordered vacancy-structure was assigned to the high temperature γ-phase. The vacancy structure is characterized by N ≃ 416 (330.7 Cu + 85.3 Sn) and 16 holes on 432 lattice sites. The holes occupy 000 and ½½½ sites in the cubic lattice; each of the cubic

octants have an edge of 18.3054 Å at 700°C. The 85.3 Sn atoms and 18.7 Cu atoms are distributed statistically over the remaining 104 of the 108 Sn sites of the γ-Cu_5Sn lattice. Cu atoms occupy 312 of the 324 Cu sites in the γ-Cu_5Sn lattice. (W.L.G.)

42857 LOW-TEMPERATURE FLOW AND FRACTURE BEHAVIOR OF TANTALUM. Nunes, J.; Anctil, A. A.; Kula, E. B. (Army Materials Research Agency, Watertown, Mass.). Advan. Cryog. Eng., 10: 102-9(1965).

Low-temperature tension tests were performed on bar stock of fully recrystallized, arc-melted tantalum over a range of temperatures from +200 to -269°C. The basic tensile, plastic flow, and fracture parameters were determined from stress-strain data that were obtained from load-profile measurements. (D.C.W.)

42858 TRANSITION-METAL OXIDES WITH METALLIC CONDUCTIVITY. Goodenough, John B. (Massachusetts Inst. of Tech., Lexington). Bull. Soc. Chim. France, No. 4, 1200-7(Apr. 1965).

Two possible mechanisms for metallic conductivity in transition-metal oxides are discussed: band formation on the transition-meta subarry and band formation via π-bonding orbitals. This permits a general classification of metallic oxides. Two electron-trapping mechanisms are also discussed: d-orbital localization via metal-metal homopolar-bond formation and π-orbital localization vial metal-nonmetal π bond formation. These ideas were applied to ReO_3-based structures, including perovskites and the various tungsten bronzes, to rutile-based structures, including the homologous series Ti_nO_{2n-1}, and to the complex β and γ vanadium bronzes. (auth)

42859 STUDY OF THE MOLYBDENUM-VANADIUM-OXYGEN SYSTEM IN THE COMPOSITION RANGE MoV_2O_{8-x} $(0 \leq x \leq 2)$. Freundlich, William; Paileret, Paulette (Faculte des Sciences, Paris). Compt. Rend., 261: 153-5 (July 5, 1965). (In French).

The degradation of MoV_2O_{8-x} $(0 \leq x \leq 2)$ by progressive Mo reduction of an equimolecular mixture of the two oxides MoO_3 and V_2O_5 was studied. Three stages in the reaction were distinguished: stoichiometric evolution of MoV_2O_8(I) and appearance of $MoV_2O_{7.5}$(II); decomposition of phase II to form phase III, $MoVO_5$ and VO_2 (Mo^{6+}, V^{5+}, V^{4+} with $1 > V^{5+}/V^{4+} \geq 0$); and decomposition of III to form a solid solution, $MoO_2 \cdot 2VO_2$ (Mo^{6+}, Mo^{4+}, V^{4+} with $Mo^{6+}/Mo^{4+} \geq 0$). (tr-auth)

42860 USING THE METHOD OF SMALL-ANGLE X-RAY SCATTERING TO INVESTIGATE THE DISPERSE STRUCTURE OF FINELY PULVERIZED GRAPHITE. Plavnik, G. M.; Feigin, L. A. (Inst. of Physical Chemistry, Academy of Sciences, USSR; Inst. of Crystallography, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 161: 395-8(Mar. 11, 1965). (In Russian).

The analysis of x-ray scattering in the small-angle region (in the immediate neighborhood of the primary beam) is a highly promising method of investigating the structure of highly disperse graphite preparations. This method combines the advantages of both the adsorption and the x-ray (wide-angle) methods and makes it possible to simultaneously determine all the principal features of disperse systems-unit surface area, mean dimensions and shape of particles, degree of polydispersity. Specimens of natural Tayginka graphite pulverized for 1, 3, 10, and 26 hr were investigated. Weighed portions of the powder were poured into cuvettes with windows covered by a thin (20 μ) polymer film translucent with respect to x rays. The intensity of small-angle x-ray scattering was measured in a specially designed setup with five-slit optics (three collimator slits and two receiving slits) adapted to the range of scattering angles from 1′ to 5°. It was found that as the dispersion time increases the intensity of small-angle scattering sharply increases. The shape of the scattering particles can be determined from the nature of the scattering curves. The longer the pulverization time the steeper is the "main part" of the curves (the region of the smallest angles). Such a course of the curves indicates a lamellar shape of the scattering particles, as confirmed by electron microscopic data. Thus, the dispersion of graphitic materials is accompanied by the formation of extremely minute ($R_{inertia}$ = 35-50 Å) flat particles characterized by a high degree of poly-dispersity ($\sigma \approx 1$). In this connection, the surface area reaches several hundred square meters per gram. Thus, the method of small-angle scattering of x rays makes it possible to obtain a sufficiently complete picture of the disperse structure of colloidal systems and, in many cases, provides information normally obtainable only with the aid of two methods-adsorption and x-ray wide-angle diffraction. (ATD)

42861 STRUCTURE AND PHYSICAL PROPERTIES OF WC-TaC-Co AND WC-NbC-Co ALLOYS. Funke, V. F.; Tumanov, V. I.; Panov, V. S. (All-Union Research Inst. of Hard Alloys, USSR). Fiz. Metal. i Metalloved., 19: 858-62(June 1965). (In Russian).

X-ray, metallographic, and electrochemical studies were made of WC-TaC-Co and WC-NbC-Co systems with cobalt contents of 13 and 39 at. % and various ratio of TaC(NbC):WC. Anomalous changes in properties appearing in the systems with an increased amount of TaC(NbC) up to 10 mole % is explained by the variations in the bonding phase and by the distribution. Phase diagrams of the systems were constructed and analyzed. (R.V.J.)

42862 HARDNESS OF CERTAIN RARE EARTH SILICIDES. Samsonov, G. V.; Verkhoglyadova, T. S.; Dvorina, L. A. (Inst. of Problems in Metallography, Academy of Sciences, Ukrainian SSR). Fiz. Metal. i Metalloved., 19: 939-41(June 1965). (In Russian).

Microhardness of Sc, Y, La, Ce, Pr, and Nd silicides were measured under various loads. Graphical data showed that the microhardness varied up to a certain load value and after that it varied only slightly. The optimum load for scandium and praseodymium silicides was 50 to 100 g, for yttrium 40 to 50 g, for lanthanum 30 to 80 g, and for cerium and neodymium 40 to 100 g. The highest hardness and friability was observed in rare earth monosilicides as a result of uniform distribution of electron density and considerable bond of Me-Si. In lower silicides (Me_5Si_3) with Cr_5B type structure, the metal-metal bond prevailed, which resulted in higher hardness in comparison to disilicides. (R.V.J.)

42863 EFFECTS OF POWDER PARTICLE SHAPE ON ELASTIC PROPERTIES OF SINTERED ALLOYS. Wu, Tai Te (Brown Univ., Providence). Intern. J. Powder Met., 1: 8-12(1965).

The elastic properties of an alloy manufactured by compacting and sintering powder particles can be controlled with the proper selection of particle shape. This knowledge provides a crucial guidance to the production of alloys made of a soft matrix strengthened by dispersed hard particles. The results indicated that among spheroidal particles disc-shaped inclusions have the greatest effect. (auth)

42864 THE Mn_5Si_3 TYPE COMPOUNDS IN SILICON ALLOYED RARE EARTH METALS. Gladyshevskii, E. I. (Baikov Inst. of Metallurgy, USSR). Izv. Akad. Nauk SSSR, Neorgan. Materialy, 1: 868-72(June 1965). (In Russian).

The existence of the silicides Mn_5Si_3 where Mn = Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu was established by x-ray structure analysis and the crystallographic structure of these compounds was determined. All the compounds belong to the structure type Mn_5Si_3. The lattice parameters are tabulated. All known structural types of the rare earth silicides were examined from the viewpoint of the reciprocal distribution of the polyhedrons [SiM_6], generated around the Si atom. (tr-auth)

42865 HYDROTHERMAL SYNTHESIS AND CRYSTALLINE STRUCTURE OF RARE EARTH HYDROXIDES. Klevtsov, P. V.; Sheina, L. P. (Inst. of Inorganic Chemistry, Academy of Sciences, Siberian SSR). Izv. Akad. Nauk SSSR, Neorgan. Materialy, 1: 912-17(June 1965). (In Russian).

Rare earth hydroxides with the composition $M(OH)_3$ for the elements from La to Yb and of the composition MOOH

for Nd and all subsequent elements were synthesized from their lanthanides in aqueous NaOH solutions by hydrothermal methods. $M(OH)_3$ is stable at a much lower temperature than MOOH. The temperature for their common conversion is reduced with increasing atomic number from >600 for Nd to 120°C for Yb. By x-ray analysis it was found that all the synthesized trihyde hydroxides belong to the structure type UCl_3 and the monohydroxides to the structure YOOH. (tr-auth)

42866 NEUTRAL AND IONIC DESORPTION OF CESIUM FROM TUNGSTEN. Schmidt, Lanny D.; Gomer, Robert (Univ. of Chicago). J. Chem. Phys., 43: 2055-63 (Sept. 15, 1965).

Rates of neutral and ionic desorption of Cs from tungsten field emitters were measured as functions of temperature and coverage, and the corresponding activation energies and frequency factors of desorption determined. The results for neutral desorption agree extremely well with the data of Taylor and Langmuir for coverages from near zero to 1.4×10^{14} atom/cm^2, but fall below the heats of these authors at higher coverages. The combination of neutral and ionic heats yields a value of $\phi = 5.3$ ev for the zero coverage work function of the regions from which ionic desorption occurs, in agreement with previous results for potassium. It is shown that surface equilibrium leads to a different averaging than independent evaporation, so that the above result is to be expected. The phenomenon of phase segregation observed by Taylor and Langmuir at very low coverages under steady-state conditions is discussed and shown to be a kinetic rather than a thermodynamic effect. (auth)

42867 MAGNETIC CHARACTERISTICS OF LANTHANIDE–BISMUTH COMPOUNDS. Tsuchida, T.; Wallace, W. E. (Univ. of Pittsburgh). J. Chem. Phys., 43: 2087-92(Sept. 15, 1965).

The magnetic behavior of the series of lanthanide–bismuth compounds having the formula LnBi was investigated over a range of temperature extending from 4 to 300°K and at field strengths ranging from 5 to 21 kOe. Ln represents Ce, Pr, Nd, Sm, Gd, Tb, Dy, and Er. Curie–Weiss behavior was observed in the upper portion of the temperature range covered for all except SmBi. Effective moments were obtained which were in close agreement with that expected from theory for the free tripositive ions. The behavior for SmBi resembles that of elemental Sm and other Sm intermetallics and is attributed to contribution of the first excited multiplet ($J = \frac{7}{2}$). Antiferromagnetic ordering was observed for all compounds except the Pr and Sm. A Néel point for the latter probably exists but below 4°K. PrBi exhibits only Van Vleck paramagnetism to the lowest temperatures studied. This is ascribed to crystal field splitting which produces a singlet (nonmagnetic) ground state. From the limiting susceptibility an over-all splitting by the crystal field of 140 cm^{-1} is estimated. CeBi exhibits metamagnetism with a critical field of about 10 kOe. Its behavior as a metamagnet is atypical and is generally complex in the region where magnetic ordering occurs. (auth)

42868 DETERMINATION OF THE DENSITY AND DIELECTRIC CONSTANT OF THIN Ta_2O_5 FILMS. Klerer, Julius (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Electrochem. Soc., 112: 896-9(Sept. 1965).

The density of anodically formed Ta_2O_5 thin films on sputtered tantalum was measured in situ. The method used was measurement of the average density of the assemblage tantalum-tantalum oxide and subsequent separation of the contributions of each component to this measured density. From a knowledge of the stoichiometry of the reaction, both the thickness and the angstrom per volt values (thickness of oxide formed per volt) could be determined for the oxide. Application of the capacitance formula for a parallel-plate capacitor led to a value for ϵ. The values obtained were: density; 8.00 g/cm^3 ± 2.4%; anodization constant, 16.0 Å/v ± 3.2%; and dielectric constant, 21 ± 3.3% at 1 kcps. (auth)

42869 THE SOLUBILITY OF PLUTONIUM IN α THORIUM. Portnoff, A. Y.; Calais, D. J. Less-Common Metals, 9: 74-6(1965). (In French).

The solubility of plutonium in α-Th as a function of the temperature was determined by point microanalysis of a biphase alloy. Samples of this alloy containing approximately 50% Pu were annealed between 400 and 600°C for periods of the order of 1000 hrs. in order to obtain thermodynamic equilibrium. The results showed that the solubility in atomic percent varies from 46 at 600° to 29.6 at 400°C. (J.S.R.)

42870 LOW-TEMPERATURE RESISTIVITY AND MAGNETIC SUSCEPTIBILITY OF PLUTONIUM MONOCARBIDE. Lallement, R.; Costa, P.; Pascard, R. (CEN, Fontenay-aux-Roses, France). J. Phys. Chem. Solids, 26: 1255-60(Aug. 1965). (In French).

The resistivity of sub-stoichiometric plutonium carbides was measured as a function of carbon content. Magnetic susceptibility measurements by other workers on these compounds were analyzed. In order to explain the strong variations of the magnetic properties of PuC with the carbon content, a model was suggested for which the six plutonium atoms next to a carbon vacancy loose their magnetic moment, probably through quenching. Resistivity and magnetic susceptibility measurements on plutonium oxycarbides were in good agreement with this hypothesis. (auth)

42871 INFLUENCE OF THE Si-V AND Si-Cr BARRIERS ON THE DIFFUSION OF ALUMINIUM AND URANIUM. Casteels, F. (SCK/CEN, Mol. Belg.); Richards, M. Mem. Sci. Rev. Met., 62: 471-8(June 1965). (In French).

The multiple barriers V + Si and Cr + Si were much more effective than the simple barriers in limiting the interdiffusion of uranium and aluminum. The Cr + Si barrier is preferable because it is easier to produce and gives slightly lower rates of penetration. The chromium can be deposited electrochemically and the silicon thermochemically. (auth)

42872 A NIOBIUM ZINC OXIDE AND TWO NIOBIUM ZINC NITRIDES WITH η-CARBIDE STRUCTURE. Stadelmaier, H. H.; Meussner, R. A. (North Carolina State Univ., Raleigh; Naval Research Lab., Washington, D. C.). Monatsh. Chem., 96: 228-31(1965). (In German).

The reaction of zinc with niobium–oxygen or niobium–nitrogen system produced ternary phases with the η-carbide structure. The lattice constant of the oxide was 11,549 Å and those of the nitrides were 11,545 and 11,655 Å. The composition of the oxide is $Nb_3Zn_3O_{0.4}$. (auth)

42873 THE CRYSTAL STRUCTURE OF Ta_3Be. Ganglberger, E.; Laube, E.; Nowotny, H. (Universitaet, Vienna). Monatsh. Chem., 96: 242-5(1965). (In German).

Ta_3Be was prepared by sintering of the components at 1300°C. The crystal structure, of Ta_2Be was found to be isotopic with $CuAl_2$. (auth)

42874 INVESTIGATIONS IN THE TERNARY SYSTEMS: {V, Nb, Ta}–Cu–Al AND Ta–Ni–Cu. Oesterreicher, H.; Nowotny, H.; Kieffer, R. (Technische Hochschule, Vienna). Monatsh. Chem., 96: 351-9(1965). (In German).

The equilibria of these systems were partially established using x-ray methods. The samples were prepared by sintering of the powder components. No ternary phase was detected for V–Cu–Al, however there was some solubility of Cu aluminides in VAl_3 and V_5Al_8. Several ternary phases occurred within the Nb–Cu–Al system. One of these was the Laves phase $Nb(Cu, Al)_2$ having a large range of homogeneity. Formation of an irregular shift structure was observed with some alloys containing $Nb(Cu, Al)_2$. Both structural elements of the cubic and hexagonal type were obviously present. The constitution of the Ta–Cu–Al alloy appeared to be very similar to the former ternary system. No ternary compound was found in the Ta–Ni–Cu system, however there was an extended substitution of nickel by copper within the Ta–Ni-phases. The Ta–(Ni,Cu) phases were in equilibria with (Ni,Cu) solid solutions. (auth)

42875 REPORT ON THE SYSTEM MERCURY–THORIUM. Ettmayer, P. (Technische Hochschule, Vienna). Monatsh. Chem., 96: 443-9(1965). (In German).

Measurements of the pressure of mercury over alloys

of mercury with thorium of various compositions, carried out by Jangg and Steppan indicated the existence of three intermetallic compounds, $ThHg_3$, $ThHg_2$, and ThHg. The vapor pressure isotherms showed definite inconsistencies at the compositions 25 at. % Th, 33 at. % Th, and 50 at. % Th. It was possible to obtain a pure compound by interrupting the pressure-controlled distillation fro.n a mercury-rich alloy at the moment of a sharp drop in the mercury vapor pressure. This technique has decisive advantages in the investigation of two-component systems, if compared with the customary method which alloys predetermined ratios of two components: at the point of sudden transition of the vapor pressure isotherms a pure and homogeneous phase can be obtained. Thus, it is possible to determine the composition of this phase with a precision which hardly can be obtained with other methods. In addition, the system remains in a state of equilibrium. Following this technique, $ThHg_3$, $ThHg_2$, and ThHg could be prepared. The structures of $ThHg_3$ and $ThHg_2$ were elucidated, and important indications of the correct structure of ThHg could be obtained. (auth)

42876 COLOR AND CONSTITUTION IN INORGANIC SOLIDS, 10TH COMMUNICATION. Schmitz-Dumont, O.; Kasper, Horst (Universitaet, Bonn, Ger.). Monatsh. Chem., 96: 506-15(1965). (In German).

Mixtures of oxides were sintered at 950°C to produce $Cu_2In_2O_5$; this decomposes at temperature above 1000°C with loss of O_2 and formation of Cu_2O. Weissenberg projections indicate an orthorhombic cell, with lattice constants $a' = 24.62$, $b' = 10.35_7$, $c' = 3.28_6$ Å; density = 6.74 g/cm³, molecules/cell = 8. The reflection curve shows maxima at 14,300 cm^{-1} and in the region of 27,000 cm^{-1}. Two shoulders appear on the first maximum at about 12,000–13,000 cm^{-1} and 15,500–16,500 cm^{-1}. The compounds $Cu_2Yb_2O_5$, $Cu_2Er_2O_5$, $Cu_2Y_2O_5$, $Cu_2Dy_2O_5$, and $Cu_2Tb_2O_5$, prepared in similar fashion, have the following, a', b', c', (Å), and reflection maximum and shoulders (cm^{-1}): 24.70, 10.702, 3.435, 14,300, 12,000, 16,500; 24.88, 10.777, 3.469, 14,300, 11,700, 16,700; 24.92, 10.801, 3.495, 14,300, 11,500, 17,300; 24.97, 10.840, 3.521, 14,400, 11,500, 17,500; 25.02, 10.855, 3.539, -, -, -. Sintering of an oxide mixture at 1070°C gave $CuInYbO_4$. A decrease in the ratios a'/c', b'/c', and a'/b' was observed with increasing ionic radius of the tervalent metal. A table of observed and calculated intensities for a powder pattern of $Cu_2In_2O_5$ is given. (BBB)

42877 TEMPERATURE DEPENDENCE OF HYPERFINE FIELDS IN DYSPROSIUM INTERMETALLIC COMPOUNDS; $DyCo_5$, $DyNi_5$. Nowik, I.; Wernick, J. H. (Bell Telephone Labs., Inc., Murray Hill, N. J.). Phys. Rev., 140: A131-5(Oct. 4, 1965).

The Mössbauer technique is used to investigate the temperature dependence of the effective fields acting on ^{161}Dy nuclei in two intermetallic, Cu_5Ca-structure-type compounds. From these measurements the temperature dependence of the dysprosium sublattice magnetization is derived. The results are compared with macroscopic magnetization measurements and with the predictions of theoretical models. In the case of $DyCo_5$ the molecular-field model gives a very good approximation. The exchange field acting on Dy spins at 0°K is estimated to be $\beta_0 H_{exc}/K = 142$°K. The value of the magnetic hyperfine interaction at 4°K in $DyCo_5$ is $g_{\mu n} H_{eff} = -862 \pm 15$ Mc/sec and in $DyNi_5$ it is -790 ± 25 Mc/sec. The value of the effective field acting on ^{161}Dy nuclei in $DyNi_5$ corresponds to an ionic magnetic moment of $9.3 \pm 0.3 \mu_B$. This value is higher than that obtained by magnetic measurements ($8.6 \mu_B$) and might indicate that the Ni sublattice contributes to the total magnetization by an antiferromagnetic coupling. (auth)

42878 MAGNETORESISTANCE OF Sc SINGLE CRYSTALS. Bogod, Yu. A.; Eremenko, V. V. (Physical Technical Inst. for Low Temperatures, Academy of Sciences, Kharkov, USSR). Phys. Status Solidi, 11: 51-3(Sept. 1, 1965).

The results of measurements of the magnetoresistance of scandium single crystals at 20.4°K in transverse pulsed magnetic fields up to 90 kgauss are presented. The results rule out a closed Fermi surface with unequal numbers of carriers of different types. (D.C.W.)

42879 LOW TEMPERATURE ADSORPTION OF NORMAL AND EQUILIBRIUM HYDROGEN AND DEUTERIUM ON SILVER AND GRAPHITE. Van Itterbeek, A.; Hellemans, R.; Van Dael, W. (Instituut voor Lage Temperaturen en Toegerpaste Fysica, Louvain). Physica, 31: 709-18 (May 1965).

Adsorption isotherms are measured for hydrogen and deuterium, in normal and 20.4°K equilibrium ortho-para concentrations, at 20 and 17°K on granular silver and graphite. The pressure and temperature parameters being equal, a preferential adsorption is found for the heavier isotope and besides this also for the modification that can lose a rotational degree of freedom. Adsorption energies were calculated only for the gas mixtures with low temperature equilibrium concentration. (auth)

42880 DEPENDENCE OF THE TECHNOLOGICAL PROPERTIES OF TANTALUM AND NIOBIUM ON THE PHYSICO-CHEMICAL CHARACTERISTICS OF THE INITIAL POWDERS. Amosov, V. M.; Bobkova, N. N.; Dianov, V. V. Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 7, 19-24(July 1965). (In Russian).

The dependence of the technological properties of tantalum and niobium on certain physico-chemical properties of the intial powders is discussed. The granulometric and chemical composition of tantalum and niobium powders used for obtaining compact metal by powder metallurgy methods is considered. (auth)

42881 OBTAINING AND INVESTIGATING SOME CERMETS OF TITANIUM NITRIDE–MOLYBDENUM. Brokhin, I. S.; Friedman, A. A. Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 7, 34-40(July 1965). (In Russian).

The hot pressing method was used to obtain cermets of TiN–Mo with a content of from 5 to 80 vol % molybdenum. Titanium nitride was prepared for the alloys (with a composition close to the stoichiometric) by direct nitrogenization of pure titanium powder. The microstructure and phase composition of experimental alloys showed that no interaction occurred between the components. The strength and hardness, as well as the scale resistance, of these cermets were determined over a temperature range of 900 to 1300°C in a test of short duration (up to 2 hours). (auth)

42882 THE THERMAL STABILITY AND REARRANGEMENT OF FIELD-EVAPORATED TUNGSTEN SURFACES. Bassett, D. W. (National Chemical Lab., Teddington, Middx., Eng.). Proc. Roy. Soc. (London), Ser. A, 286: 191-203(June 22, 1965).

The changes that occurred on heating a field-evaporated tungsten surface were investigated at the atomic level by means of field ion microscopy. The tungsten surfaces were cleaned by heating before field evaporation, so that surface rearrangement observed was due only to the movement of tungsten atoms. It is shown that because of the imaging conditions, only displacements of atoms from one surface site to another of at least equal binding energy were directly observable. Apart from small change at 300°K, which may have been due to the elimination of defects from the edges nearer to (001) of the (123) and (112) planes, the first observable changes were displacements of atoms from one kink to the next, in the edges of lattice planes. At 500°K atoms were displaced along the edges of (011) terraces from one kink site of (111) type to the next, with an activation energy of 1.8 ev, while displacement from the (001)-like kinks occurred at a slightly higher temperature, with an activation energy of 2.1 ev. Similar displacements along the edges of (111) and (001) terraces occurred at 600 to 700°K, with activation energies of 2.2 and 2.3 ev, respectively. The difference between these activation energies and the higher values calculated for the particular atom displacements from the simple pairwise interaction model of surface forces is discussed. At temperatures above 850°K, surface rearrangement with a consequent lowering of surface energy was extensive. Enlargement of the (112) and (011) planes occurred by removal of their topmost

layers by surface diffusion processes. Changes in local surface topography observed include, the extension of unbroken rows of close-packed atoms where these formed the edges of lattice planes, the formation of surface steps several atom layers high, and local roughening due to the random movement of surface atoms. (auth)

42883 INVESTIGATIONS OF THE ALUMINIUM–ALUMINIUM OXIDE MATERIAL FRITTOXAL FOR NUCLEAR APPLICATIONS. Biais, R.; Moisan, J.; Jehenson, P.; Herenguel, J. Rev. Met. (Paris), 62: 489-8 (May 1965). (In French).

Advantages of the use of slightly oxidized fine powders (1 micron), which give finished products with good heat-resistance and acceptable elongations at fracture under creep, are discussed. The use of very pure aluminum powders gives a sound structure but does not improve creep ductility. Thermal cycling behavior between 300 and 500°C and resistance to terphenyl are satisfactory. (auth)

42884 HARD SUPERCONDUCTORS. Klose, Wolfgang. Siemens-Z., 39: 446-9(May 1965). (In German).

The special properties of hard superconductors are discussed in conjunction with work carried out in the research laboratory. (D.C.W.)

42885 ELECTRON DIFFRACTION STUDY OF ONE OF THE CUBIC OXIDES OF NIOBIUM. Klechkovskaya, V. V.; Troitskaya, N. V.; Pinsker, Z. G. (Inst. of Crystallography, Academy of Sciences, USSR). Soviet Phys.-Cryst. (English Transl.), 10: 28-35(July-Aug. 1965).

Translated from Kristallografiya, 10: 37-46(Jan.-Feb. 1965).

The structures of thin films of the cubic niobium oxide with a unit cell constant of a = 7.80 Å were investigated. It was established that they belonged to the space group O_h^1 with the atomic positions Nb: 1(a), 1(b), 3(c), 3(d), 8(g) and O: 24(k)Oyz, where y = ¼, z = 0.47; 24(k)Oyz, where y = ¼, z = 0.03; 24(l)½yz, where y = ¼, z = 0.47; and 24(l) ½yz, where y = ¼, z = 0.03. The niobium positions 1 (a), 3 (c), 3 (d), and 8 (g), and the oxygen positions are defect positions. The possible limits of composition of the oxide are from $NbO_{1.64}$ to $NbO_{1.68}$. The theoretical density is 3.05 g/cm³. (auth)

42886 PRODUCING SINGLE-CRYSTAL PLATES OF COBALT–IRON ALLOY FOR THE POLARIZATION OF NEUTRONS. Ovcharov, V. P.; Aleshko-Ozhevskii, O. P. (Inst. of Crystallography, Academy of Sciences, USSR). Soviet Phys.-Cryst. (English Transl.), 10: 76-8(July-Aug. 1965).

Translated from Kristallografiya, 10: 96-8(Jan.-Feb. 1965).

A method of growing large (100-mm long, 45-mm diameter) single crystals of Co–8% Fe alloy is described, together with the preparation from these of single-crystal plates for producing a beam of monoenergetic polarized neutrons. The beam so obtained had 95% polarization and an intensity adequate for carrying out structural investigations. (auth)

42887 CALORIMETRIC STUDY OF THE LUMINOUS ENERGY OF COMBUSTION OF Mg AND Zr IN OXYGEN. Tachoire, H. (Inst. of Microcalorimetry, Marseilles); Calvet, E.; Skinner, H. A.; Chastel, R. Trans. Faraday Soc., 61: 1068-71(June 1965).

The combustion in O_2 of samples of Mg and Zr wire was studied using a silica micro-bomb fitted inside a Calvet microcalorimeter. The recorded thermograms showed two well-separated peaks, enabling measurement of the luminous energy of combustion as a fraction of the total combustion energy evolved. On combustion of Mg wire, 11.5% of the total combustion energy was evolved as light; combustion of Zr wire evolved 19.4% of the total as light. (auth)

42888 RENII. TRUDY II VSESOYUZNOGO SOVESHCHANIYA PO PROBLEME RENIYA 19–21 NOYABRYA 1962 g. (Bulletin of the Second All-Union Conference on Problems of Rhenium, Moscow, November 19–21, 1962). Savitskii, E. M. (ed.). Moscow, Izdatel'stvo Nauka, 1964. 259p. (CONF-621103).

Fifty-two papers are presented on rhenium production technology and physical and mechanical properties of rhenium alloyed with high-melting metals. Data are given on the crystal chemistry of rhenium compounds and uses of rhenium in electronics, electrical technology, thermocouples, and industries using high-melting materials. (R.V.J.)

42889 RECENT RESULTS ON THE CRYSTAL PHYSICS OF WHITE TIN. Borgonovi, G.; Caglioti, G.; Antonini, M. (EURATOM, Ispra, Italy). pp 117-30 of STI/PUB/92(Vol.I).

Preliminary measurements of the frequencies of some normal modes of white tin (double body-centered tetragonal) have been made utilizing the three-axis crystal spectrometer of Ispra. Frequency versus wave-vector dispersion relations at room temperature have been obtained for a number of normal modes propagating along the [001] direction. The experimental results are compared with calculations by Wolfram, Lehman, and De Wames (WLD) using the axially symmetric model. The theoretical values, based on the experimentally determined elastic constants, are not in agreement with our experimental results, since the numerical value of the maximum observed frequency is about one half of the calculated one, and the shape of the observed dispersion curve for the [001] direction is rather different from the theoretical one and seems to indicate a comparatively strong interaction between first neighbors along the c-axis. This relatively strong interaction suggests an interpertation of the dynamical structure of white tin as a chain-like structure along the c-direction. Force constants giving a more reasonable fit with the preliminary values of the experimental frequencies are evaluated using the WLD model, and a frequency distribution of the normal modes is calculated. The anomalous behavior of the anisotropy ratio of the Debye-Waller factor in white tin, revealed by Mössbauer measurements, has been checked using the technique of elastic neutron diffraction by a powder sample. The same technique has been utilized with a single-crystal sample in order to map the anomalous intensity of neutrons diffracted in the surrounding of the (002) reflection, which should be forbidden. An attempt is made to correlate these anomalous behaviors to a certain amount of static disorder present in the crystal. Such static disorder is not in contradiction to the chain-like structure proposed for white tin. (auth)

42890 THE VIBRATION SPECTRUM OF THE WHITE TIN LATTICE. Brovman, E. G.; Kagan, Yu. (Inst. of Atomic Energy, Moscow). pp 131-51 of STI/PUB/92(Vol.I). (In Russian).

The dynamic problem of vibration in white tin is considered using the Born-von Kármán model. Force constants entering into the full dynamic matrix for the first three coordination spheres are used, and interaction with the fourth co-ordination sphere is assumed to be central. In determining the elements of the dynamic matrix, both modules of elasticity and experimental data for the isotropy of the Mössbauer effect are used. The resulting dispersion curve displays marked anomalies. The frequencies of one of the optical branches, at the terminal valve, are very low, with the minimum lying on the [001] axis. This results in peculiar behavior of the distribution function for $g(\omega)$ frequencies at small values of ω, of the heat capacity at low temperatures, and of other spectrum integral characteristics. The results obtained explain the anisotropy sign of the Mössbauer effect observed in experiments at temperatures of 300 and 77°K and point to an inverted anisotropy sign at lower temperatures. (auth)

42891 LATTICE DYNAMICS OF MAGNESIUM. Iyengar, P. K.; Venkataraman, G.; Vijayaraghavan, P. R.; Roy, A. P. (Atomic Energy Establishment, Trombay, India). pp 153-79 of STI/PUB/92(Vol.I).

A group theoretical analysis of modes of vibrations in hexagonal close-packed lattices has been made. The results have been used to classify the phonons at some special points in the Brillouin zone and factorize the secular de-

terminant. Dispersion relations for phonons in magnesium along the two symmetry directions [0001] and [01$\bar{1}$0] have been measured (at room temperature) more accurately than reported earlier. The measurements have been made using a triple-axis spectrometer and a "window filter" spectrometer, both operated in the "constant-Q" mode. The results are compared with calculations based on three- and four-neighbor axially symmetric models. It is observed that the four-neighbor model gives a reasonably good description of the data. Even better agreement is obtained with a four-neighbor tensor force model. The force constants derived from the experiment are used to compute the frequency distribution. (auth)

42892 NOTE ON DISPERSION CURVE CALCULATIONS IN ZINC. Holas, A. (Inst. of Nuclear Research, Swierk, Poland). pp 205-9 of STI/PUB/92(Vol.I).

An attempt has been made to describe an irregular shape of the experimental phonon dispersion curve in [01$\bar{1}$0] direction for zinc, using harmonic approximation of the Born-von Kármán theory. The general dispersion relations for hexagonal close-packed structures given as functions of atomic force constants of an unlimited number of neighbors were employed. By means of them, the least squares fitting of theoretical curves to experimental points, considering the neighbors situated up to the distance three times lattice constant a, has been performed. In spite of that, the calculated curves do not follow experimental points satisfactorily. The observed irregularity may be explained by anharmonic or electron-phonon interaction effects rather than by harmonic theory. (auth)

42893 PHONONS IN ALUMINIUM AT 80 deg K. Stedman, R.; Nilsson, G. (Aktiebolaget Atomenergi, Studsvik, Sweden). pp 211-23 of STI/PUB/92(Vol.I).

The dispersion relations for aluminum have been determined fairly completely at 80°K by measurements with a new three-axis crystal spectrometer at the 30-Mw research reactor R2 at Studsvik. Complete dispersion curves have been obtained for the three symmetry directions, together with interpolation points on the zone boundaries and elsewhere. The results are presented as dispersion curves and as contour maps of dispersion surfaces. Attention was devoted to details such as resolution, reproducibility, and the avoidance of disturbing effects. A focusing technique was used throughout to optimize resolution. The results consequently were of a rather high degree of accuracy and were utilized to search for Kohn anomalies, but no clear examples were found. Such effects are evidently small in aluminum, but there are indications that a moderate improvement of experimental technique may render them discernible. Phonon widths at 80°K could often be determined from the widths of observed resonances via a calculated resolution width. In another series of measurements at 300°K, widths could always be determined. Examples are given of broadenings and energy shifts in passing from 80 to 300°K. A noteworthy effect was found at $\vec{q}'$ = (0.8, 0, 0). The phonon width there increased in an anomalous fashion in passing from 80 to 300°K. Points for small $\vec{q}'$ on transverse branches tend to lie significantly above the lines through the origin having slopes corresponding to the velocity of 10-Mc sound waves. (auth)

42894 THE CRYSTAL DYNAMICS OF URANIUM DIOXIDE. Woods, A. D. B.; Dolling, G.; Cowley, R. A. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp 373-8 of STI/PUB/92(Vol.I).

The normal modes of vibration of uranium dioxide have been studied by means of coherent one-phonon scattering of slow neutrons from a single crystal specimen of stoichiometric composition. The measurements, performed at room temperature, were made using the triple-axis crystal spectrometer at the NRU reactor at Chalk River, mainly by means of the "constant-Q" technique. Since the crystal structure of uranium dioxide is of the calcium fluoride type, it is possible to measure six distinct branches of the dispersion relation propagating along the highly symmetric directions [00ζ], [$\zeta\zeta$0], and [$\zeta\zeta\zeta$], with the crystal oriented in the (1$\bar{1}$0) mirror plane. (ζ is a wave vector co-ordinate expressed in reciprocal lattice units.) There are three frequencies for the long wavelength optic modes of the calcium fluoride structure. In uranium dioxide the triply-degenerate mode has a frequency of 13.42 ± 0.16 (units 10^{12} cps), the transverse optic mode a frequency of 8.52 ± 0.11, and the longitudinal mode a frequency of 16.7 ± 0.6. These results may be used together with the measured refractive index, and the relation connecting the frequencies of the optic modes and the dielectric constants, to predict a static dielectric constant of 20.4 ± 1.5. The frequencies of the acoustic modes with wave vector (0,0,1) are for the transverse branch 3.27 ± 0.08, and for the longitudinal branch, 5.27 ± 0.08. For the wave vector (0.5, 0.5, 0.5), the corresponding frequencies are 2.75 ± 0.04 and 5.24 ± 0.10. The slopes of the acoustic dispersion curves at long wavelengths enable the elastic constants to be predicted as follows: C_{11}, 4.2 ± 0.2; C_{12}, 1.3 ± 0.2; C_{44}, 0.75 ± 0.06 (units 10^{12} dyn/cm^2). (auth)

42895 APPLICATION OF PYROLYTIC GRAPHITE TO SPACE RADIATORS. Holl, Richard J.; Goldstein, A. (Douglas Aircraft Co., Inc., Santa Monica, Calif.). New York, American Inst. of Aeronautics and Astronautics, 1965, Preprint No. 65-288, 8p., $1.00. (CONF-650711-46). ORINS.

From AIAA 2nd Annual Meeting and Technical Demonstration, San Francisco.

Numerous analyses showed that beryllium and pyrolytic graphite have the greatest theoretical potential as armorfin materials for high-temperature, high-performance space radiators. However, both materials displayed excessive damage on simulated meteoroid impact. Results of hypervelocity impact tests on an expanded form of pyrolytic graphite, which did not show this excessive damage, are reported. Pyrex projectiles 1/16-in. diameter were impacted at 23,000 ft/sec on samples of the material expanded in the "c" direction to a density of 40 lb/cu ft. Damage was limited to the primary crater, which had a depth of 0.51 in. The "spall" factor was found to be less than 1.6. This armor effectiveness improved on the theoretical value of normal pyrolytic graphite by about a factor of two and was approximately equal to the theoretical effectiveness of beryllium at an operating temperature of 1300°F. Combined with only a slight decrease in thermal conductivity, these results gave expanded pyrolytic graphite potential performance, for high-temperature space radiators exceeding the theoretical, and probably unattainable, values of beryllium or normal pyrolytic graphite. (auth)

42896 ELECTRICAL PROPERTIES AND DEFECT STRUCTURE OF Y_2O_3–ThO_2 SOLID SOLUTIONS. Wimmer, J. M.; Bidwell, L. R.; Tallan, N. M. 14p. (CONF-650513-7). Gmelin, AED-CONF-65-092-8.

From American Ceramic Society, Annual Meeting, Philadelphia.

Density measurements on sintered disks of Y_2O_3–ThO_2 solid solution up to 16 mole % Y_2O_3 support an anion vacancy model. The nominal composition 93 mole % ThO_2–7 mole % Y_2O_3 i.e., $Th_{0.87}$ $Y_{0.13}$ $O_{1.935}$ is shown to be an essentially ionic conductor over a wide temperature and oxygen pressure range with mixed conduction at the higher oxygen partial pressures. Transference numbers calculated from electrochemical cells using the material as an electrolyte were compared to those obtained from an electrical polarization technique. (auth)

42897 SUPERCONDUCTIVITY IN $SrTiO_3$. Schooley, James F. 5p. (CONF-650220-3). Gmelin, AED-CONF-65-002-1.

From American Physical Society, Southwest Meeting, Norman, Okla.

Superconductive and normal properties of $SrTiO_3$ are discussed. The origin of superconductivity in $SrTiO_3$ is ascribed to intervalley electron-phonon scattering, which at low electron densities is unaffected by screening. (P.C.H.)

42898 ELECTRICAL PROPERTIES AND DEFECT STRUCTURE OF Y_2O_3. Tallan, N. M.; Vest, R. W. 10p. (CONF-650513-6). Gmelin, AED-CONF-65-092-7.

From American Ceramic Society, Annual Meeting, Philadelphia.

Conductivity measurements were made with one single crystal of Y_2O_3, and three polycrystalline Y_2O_3 samples. The conductivity of Y_2O_3 was found to be frequency independent over the range 20 cps to 20 kc. The defect structure is discussed. Mass action equations were written for Schottky disorder, Frenkel disorder, oxidation-reduction, and all possible ionization steps for anion and cation vacancies and interstitials in addition to the single oxidation or reduction of a cation impurity. (P.C.H.)

42899 ALUMINA–COBALT–GOLD COMPOSITION. Levey, R. P. Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,208,848. Sept. 28, 1965.

The properties of a strong hard material consisting essentially of 80–97% alumina and 3 to 20% of a mixture of the metals cobalt and gold are given. Articles made from this composition are useful in high pressure, high temperature equipment and as cutting tips for machine tools. (AEC)

Radiation Effects

See also CHEMISTRY — Radiation Chemistry.

Refer also to abstracts 43606 and 43618.

42900 (BMI–1739) EFFECTS OF LOW-TEMPERATURE IRRADIATION AND SUBSEQUENT ANNEALING ON THE THERMAL DIFFUSIVITY OF PYROLYTIC CARBON AND PYROLYTIC GRAPHITE. Wood, Webster D.; Deem, Herbert W.; Goldthwaite, William H. (Battelle Memorial Inst., Columbus, Ohio). Aug. 3, 1965. Contract W-7405-eng-92. 26p. Dep. mn; CFSTI $0.75 cy, $0.50 mn.

Thermal-diffusivity measurements were made on unirradiated and irradiated pyrolytic graphite and pyrolytic carbon. The annealing of irradiation damage was studied with specimens which had been irradiated with fast neutrons (>1 Mev) to levels of 2×10^{18}, 2×10^{19}, and 4×10^{20} nvt. Analyses of the activation energies of the annealing process were made on the basis of the thermal-diffusivity measurements and, in general, it was found that the annealing of the irradiation damage for pyrolytic graphite and pyrolytic carbon was the same as for reactor-grade graphite. (auth)

42901 (BNWL–SA–151) RADIATION DAMAGE IN MOLYBDENUM AFTER HIGH NEUTRON EXPOSURE. Mastel, B.; Brimhall, J. L.; Bierlein, T. K. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). July 29, 1965. Contract AT(45-1)-1830. 9p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

A brief review is given of the effects of short neutron exposures (10^{19} nvt) on molybdenum containing <10 ppm and 150 ppm carbon. In contrast to the low exposures, the high exposure (10^{20} nvt) gave similar results on all samples. The defect clusters and dislocations in the microstructures are discussed. The effects of annealing at 575 and 750°C were studied. (D.L.C.)

42902 (FZK–243) MEASURED EFFECTS OF THE VARIOUS COMBINATIONS OF NUCLEAR RADIATION, VACUUM, AND CRYOTEMPERATURES ON ENGINEERING MATERIALS. Quarterly Progress Report, January 1–March 31, 1965. Kerlin, E. E.; Smith, E. T. (General Dynamics/Fort Worth, Tex.). Apr. 26, 1965. Contract NAS 8-2450. 35p.

The following information is included: a listing of the test materials selected, proposed radiation exposures and environmental test conditions, status of the materials selected for this program, and status of the modifications to the special test equipment. Information is given concerning: machining test samples, bonding specimen doublers, evaluating new materials, making minor modification to the Bearing Tester, performing a Bearing Lubricant Control Test, installing potentiometer instrumentation on the Low-Force and High-Force Testers, continuing fabrication of the LH_2 Tensile Tester, making minor modifications to the Cryomechanical Tester, fabricating two thermal conductivity testers, performing a control test on the Thermal Conductivity Tester, and irradiating samples in ambient air. (M.O.W.)

42903 (GEAP–4775) FUEL IRRADIATIONS IN THE ESADE-VBWR NUCLEAR SUPERHEAT LOOP. Hazel, V. E.; Boyle, R. F.; Busboom, H. J.; Murdock, T. B.; Skarpelos, J. M.; Spalaris, C. N. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Mar. 1965. Contract AT(04-3)-189. 136p. Dep. mn; CFSTI $4.00 cy, $1.25 mn.

The results obtained from fuel element irradiation experiments ESH-1 and ESH-1.1 are described in detail. These tests were conducted in the Expanded Superheat Advanced Demonstration Experiment (ESADE) in the Vallecitos Boiling Water Reactor (VBWR) core, using the steam generated from the boiling portion of the reactor. These experiments were significant in that it was possible to compare the reactor performance of several fuel elements simultaneously. Thus, it was shown that under identical conditions, Incoloy-800 and Inconel-600 fuel sheaths were resistant to intergranular attack, whereas Type 304 stainless steel failed. In addition, it was shown that when all other variables were held constant, loading stresses had a dominant effect upon fuel clad performance in a superheated steam environment. (auth)

42904 (IPP–2/40) UEBER DEN EINFLUSS EINES IONENBESCHUSSES AUF STRUKTUR UND SORPTIONSEIGENSCHAFTEN VON WOLFRAM-OBERFLAECHEN, BEOBACHTUNGEN MIT DEM FELDELEKTRONENMIKROSKOP. (Ion Bombardment of Tungsten by Inert-Gas Ions and Subsequent Adsorption of Oxygen as Observed in the Field Emission Microscope). Vernickel, H. (Institut fuer Plasmaphysik, G.m.b.H. Garching (West Germany)). June 1965. 19p. Dep. mn.

The tungsten point of a field emission microscope was bombarded by varying amounts of inert-gas ions (He, Ar, Xe) of 4 kev energy. During the early stages of the bombardment the work function is reduced by 0.1 ev. Continued bombardment produces a rough surface until finally the point consists of many small emitting centers and the FEM picture has almost entirely lost its structure and symmetry. For all values of the ion bombardment the change in work function and the sticking probability on a subsequent O_2-adsorption is, however, unchanged, although many defects were produced on the surface. The FEM pictures taken during the O_2-adsorption indicate that many details of the surface structure are destroyed during the bombardment. Basically, however, the crystalline structure is preserved. (auth)

42905 (NAA–SR–11134) THE HIGH-TEMPERATURE IRRADIATION BEHAVIOR OF HYPOSTOICHIOMETRIC URANIUM MONOCARBIDE. Hahn, R. D. (Atomics International, Canoga Park, Calif.). Aug. 31, 1965. Contract AT(11-1)-Gen-8. 54p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

A series of three multicompartmented experiments (EXP-NRX-85-1, -2, and -3) was designed to investigate the irradiation behavior of uranium carbide fuels, as a function of composition, temperature, and burnup; and the mechanical properties of Type 304 stainless steel, as a function of temperature and integrated thermal neutron flux. This report deals with the results obtained from the EXP-NRX-85-1 experiment. The capsule was irradiated to a maximum fuel burnup of 19,200 Mwd/MTU at maximum centerline temperatures ≥3000°F (1300°C). The fuel was swollen and the fuel claddings were failed. In the presence of sodium and a stainless steel carbon sink, hypostoichiometric UC (<4.8 wt % C) was decarburized. Significant uranium redistribution to the fuel surfaces was observed in all the fuel specimens. Uranium porosity, grain boundary separation, and lack of porosity in the carbide grains indicated fission gas release was primarily effected by grain boundary mechanisms. Fuel-cladding reactions were observed in all the elements. Ring tensile tests from the irradiated Type 304 stainless steel fuel cladding, exposed to an integrated thermal neutron flux

of 2.1×10^{21} nvt (~4.2×10^{19} nvt > 1 Mev fast flux), showed a decrease in ductility, beginning at 900°F (480°C), which did not recover at 1200°F (650°C). The ductility, compared to that at room temperature, was reduced by a factor of 3 at 1200°F. Mechanisms are postulated to account for the experimental observations. (auth)

42906 (NP-15321) RADIOISOTOPES REVIEW SHEET, G1. RADIATION STABILITY OF MATERIALS. (Atomic Energy Research Establishment, Harwell (England)). [1963]. 2p. Dep. mn; BIS Free.

A general guide is given to the radiation stability of the following types of materials: rubbers, thermoplastics, thermosets, textiles, adhesives, oils and greases, packaging materials, printing ink and paint films, inorganic fillers, glass, concrete, and metals. Storage effects, additives in plastics, dose rate, and induced radioactivity are also considered. (D.L.C.)

42907 (NUMEC-3432-12) IRRADIATION TESTING OF UO_2–PuO_2 FUELS. Quarterly Progress Report, April 1–June 30, 1965. Ross, William J.; Caldwell, Colin S.; Puechl, Karl H. (Nuclear Materials and Equipment Corp., Apollo, Pa.). Contract AT(30-1)-3432. 28p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

A summary is presented of the program on the irradiation of UO_2–PuO_2 fuels of interest for fast breeder reactors and for plutonium recycle. The powder preparation and fuel element fabrication are described, and characterization data are given. The oxide weight and density of in-pile samples are tabulated along with heating rates, interface temperatures, and burnups. (D.L.C.)

42908 (RD/B/N-220) IRRADIATION CREEP IN GRAPHITE. Williamson, G. K.; Jenkins, G. M. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Feb. 1964. 4p.

The steady state creep of polycrystalline graphite under irradiation is adequately explained above 250°C by the rearrangements in internal stresses caused by the anisotropic expansion of component crystals. At lower temperatures the creep strains predicted are greater than those observed. This is attributed to the more effective pinning of dislocations at these lower temperatures by irradiation damage. This theory does not predict any increase in total plasticity due to steady state irradiation induced creep. (auth)

42909 (RD/B/N-327) IRRADIATION CREEP IN GRAPHITE AT 40 deg C. Hesketh, R. V.; Barnett, J. T. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Aug. 1964. 8p. Dep. mn.

Five tensile and five compressive restrained growth assemblies, with initial stresses ~0.1 kg mm^{-2}, were irradiated at 40°C to a neutron dose of 10^{20} cm^{-2} (nickel flux). Two tensile specimens fractured during irradiation. In specimens which were recovered intact, the elastic strain was measured. Differential growth strains, final Young's modulii, and fracture stresses were also measured. On the assumption that the transient creep strain is proportional to stress and independent of temperature, the continuous creep strain is calculated. Its rate per unit of stress is three to six times that at 250°C, and its rate is an order of magnitude greater than the maximum predicted by the theory of dislocation unpinning. Tensile stresses four to five times the ultimate predicted by this theory are observed at strains exceeding the predicted maximum. The elastic strain to fracture is not appreciably affected by irradiation, but the total tensile strain to fracture is increased by a factor of five or six. (auth)

42910 (TRG-Report-932) FACILITIES FOR THE POST-IRRADIATION EXAMINATION OF CERAMIC FUEL ELEMENTS AT WINDSCALE. Vallely, J. (Reactor Group, United Kingdom Atomic Energy Authority, Sellafield (England)). Oct. 1964. 44p. Dep.; BIS $2.00, HMSO 10s.

A detailed description is given of the facilities, which include fuel element examination caves, general purpose caves, cursory examination line, metallography and physics line, and general purpose lines. The facilities are used to examine fuel elements irradiated in materials testing reactors, and driver charge and experimental stringers from the Windscale AGR. (D.L.C.)

42911 EFFECTS OF THERMAL NEUTRON IRRADIATION ON THE PROPERTIES OF HEAT-RESISTANT PYROCERAMICS. Brekhovskikh, S. M.; Grinshtein, Yu. L. Izv. Akad. Nauk SSSR, Neorgan. Materialy, 1: 947-51 (June 1965). (In Russian).

It was established that the pyroceramic IV-23 can be used in fields of neutron irradiation at integral doses not exceeding 5×10^{18} thermal neutrons/cm^2. The pyroceramic ZH-3 is not destroyed after irradiation with an integral dose of 10^{19} thermal neutrons/cm^2. The modification of the microhardness of the pyroceramics, having a different character for small and large irradiation doses, was detected. The change of the dielectric property of the pyroceramics has a maximum at doses depending on the composition of the material. The phenomonon of neutron hardening of the pyroceramics was observed. The assumption that change in the coefficient of thermal expansion of the pyroceramics during irradiation can be produced not only by change of the phase composition but also by the production of stress was expressed. Examination of the radiation effect in the pyroceramic IV-23 was made on the basis of the theory of thermal peaks. (tr-auth)

42912 COLOR-CENTER KINETICS IN CERIUM-CONTAINING GLASS. Stroud, Jackson S. (Corning Glass Works, Corning, N. Y.). J. Chem. Phys., 43: 2442-50 (Oct. 1, 1965).

The formation and thermal bleaching of radioinduced color centers in cerium-containing soda–silica glass were studied to determine the effect of cerium on color-center kinetics. The optical absorption changes occurring during and after irradiation with gamma and x rays were measured. The data are fit by equations obtained by integrating a set of reaction-rate equations. These equations are an approximate description of the following three processes that account qualitatively for the effects of cerium concentration and oxidation state: Ce^{3+} ions, by capturing radioinduced holes to form Ce^{3+} centers, inhibit formation of all other kinds of centers due to trapped holes; Ce^{4+} ions, by capturing electrons to form (Ce^{4+} + electron) centers, inhibit formation of all other kinds of centers due to trapped electrons and inhibit recombination of electrons with trapped holes; after cessation of irradiation, holes are transferred from their traps to Ce^{3+} ions. (auth)

42913 NEUTRON IRRADIATION EFFECTS OF ELECTRICAL PROPERTIES IN GLASSY CARBON. Shimada, Takashi (Tokai Electrode Mfg. Co. Ltd., Tokyo); Kikuchi, Takeo. J. Phys. Soc. Japan, 20: 1288-9(July 1965).

Experimental results are presented on the irradiation effects of the electric properties of glassy carbon. Three kinds of glassy carbons were used as specimens, which were heat-treated at 1300, 2000, and 3000°C and whose resistivities were 5.7, 4.6, and 4.5 mΩ-cm respectively. The specimens were irradiated at a temperature of 150–200°C up to integrated neutron flux of about 10^{20} n/cm^2, estimated from Co wire activation, including both fast and slow neutrons. Fractional changes in electric resistivities at lower temperature are larger than that at higher temperature. The resistivity of the specimen heat-treated at 3000°C first decreases for small doses to reach a minimum value, then gradually increases. Thermonuclear powers of glassy carbons were nearly constant, independent of exposure. The results of thermoelectric power indicate that Fermi level or carrier concentrations in glassy carbons are little changed by neutron irradiation. (J.F.P.)

42914 ON APPLICATION OF ELECTRON MICROSCOPY FOR INVESTIGATION OF RADIATION DEFECTS IN ALKALI-HALIDE CRYSTALS. Ekmanis, Yu. (Inst. of Physics, Academy of Sciences, Latvian SSR). Latvijas PSR Zinatnu Akad. Vestis, No. 4, 55-61(1965). (In Russian).

Investigations performed demonstrated the possibility of investigating radiation disturbances in alkali-haloid

crystals by method of electron microscopy. From data obtained, it was concluded that investigation of the defective structure of ion crystal surfaces is expediently performed by method of carbon replicas. In this way it was possible to reveal the effect of gamma-radiation on crystals of NaCl, KCl, and LiF at irradiation up to a dose of 10^9 Rad. Evidently the sensitivity of the method is sufficient for appraising also the effect of lower doses of gamma radiation (of the order 10^6 Rad). (auth)

42915 DISPLACEMENT SPIKE EFFECTS IN COPPER-RICH COPPER-IRON ALLOYS. Boltax, A. (Westinghouse Electric Corp., Pittsburgh). Nucl. Appl., 1: 337-47 (Aug. 1965).

Fast-neutron irradiation experiments were performed on a series of solution-treated, aged, and cold-worked copper-rich Cu–Fe alloys. The results obtained by electrical and magnetic measurements confirmed data reported earlier that fast-neutron irradiation can cause aging or resolution depending on the pre-irradiation conditions of the sample. The results obtained on the aged alloys were consistent with a displacement spike model, where the calculated value for the spike radius is approximately 35 Å (15,000 atoms). (auth)

42916 DETERMINATION OF STAGE I RECOVERY IN PURE ALUMINUM FOLLOWING ELECTRON IRRADIATION. Dawson, H. I.; Iseler, G. W.; Mehner, A. S.; Kauffman, J. W. (Northwestern Univ., Evanston, Ill.). Phys. Letters, 18: 247-8(Sept. 1, 1965).

The determination of the stage I recovery spectrum in high purity aluminum (99.9999%) following electron irradiation is reported. The recovery rate of the electric resistivity induced by 2 Mev electrons is given as a function of temperature. The curve is a typical example for a relatively low dose. In this case 83% of the total resistivity induced annealed out in stage I. At least 21 peaks were reproduced for different dose levels at 2 Mev, as well as for a 0.7-Mev irradiation. A dose-dependent effect was observed in the heights of the peaks. Comparison with the copper spectrum shows similarities. (J.F.P.)

42917 LUMINESCENCE AND PHOTOCONDUCTIVITY IN SILVER HALIDES. Smith, G. C. (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 140: A221-6(Oct. 4, 1965). (NYO-2471-10).

Pulsed and steady-state luminescence and photoconductivity were measured in AgCl and AgBr at low temperatures using x-ray and uv excitation. The luminescence efficiency and electron range (Schubweg) are found to be competitive forms of response as functions of temperature. In AgCl at 4.2°K electron-hole pairs are captured (or formed) at a luminescence center in about 10^{-8} sec, thus accounting for the large decrease of electron range observed at low temperatures. A model is proposed in which an intrinsic luminescence center is represented by a shallow (0.05-ev) electron trap with a characteristic lifetime for radiative recombination after electron capture of about 25 μsec. Similarity to the intrinsic luminescence of alkali halides is noted. Large dark currents of the order of mA and electroluminescence were observed in some crystals after pre-irradiation at 4.2°K. (auth)

42918 INFLUENCE OF RADIATION DAMAGE UPON THE DIFFUSION OF ARGON IN POTASSIUM CHLORIDE. Schmeling, P. (Kernforschungszentrum, Karlsruhe, Ger.). Phys. Status Solidi, 11: 175-84(Sept. 1, 1965).

The diffusion of ^{41}Ar and ^{39}Ar in single crystals of potassium chloride was studied as a function of irradiation dose. It was found that the diffusion coefficients of argon are significantly decreased by increasing the irradiation dose. The influence of neutron bombardment is considerable at low temperatures, the diffusion coefficient being changed by several orders of magnitude. The general behavior, as shown in an Arrhenius diagram, follows the same pattern independently of the irradiation dose. At high temperatures, the diffusion coefficient is constant with time and has an activation energy of 8.7 ± 0.8 kcal/mol, and an interstitial diffusion mechanism seems to be plausible. At intermediate temperatures, the diffusion coefficient increases during isothermal annealing and ultimately reaches a constant value. At low temperature, the diffusion coefficient is again constant with time. (auth)

42919 DIMENSIONAL AND X-RAY DIFFRACTION CHANGES IN IRRADIATED SINGLE CRYSTAL BeO. Austerman, S. B.; Miller, K. T. (Atomics International, Canoga Park, Calif.). Phys. Status Solidi, 11: 241-53 (Sept. 1, 1965).

Single crystals of BeO were irradiated by high-energy (≥1 Mev) neutrons to doses of 10^{20} to 6×10^{20} nvt at low temperature (<100°C). The crystal structure effects of irradiation were examined by x-ray diffraction and measurement of interfacial angles between crystallographic faces. The diffraction patterns are characterized by duplex reflections each composed of a sharp and a broad component. The sharp component is attributed to the matrix crystal volume, which is expanded by a random distribution of point defects. The broad component is attributed to the presence of interplanar clusters lying parallel to the basal plane. This structure showed little change below 800°C with short-term anneal. Between 800 and 1600°C, there was nearly complete recovery of line breadth and lattice constants. The annealing data indicate removal of the point defects and some growth of cluster size during thermal annealing. (auth)

42920 THERMALLY ACTIVE PROCESSES FOR THE DEFORMATION OF NEUTRON-IRRADIATED COPPER SINGLE CRYSTALS. I. DETERMINATION OF ACTIVATION ENERGY. Diehl, J.; Seidel, G. P.; Niemann, L. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Phys. Status Solidi, 11: 339-54(Sept. 1, 1965). (In German).

Change in strain-rate and temperature measurements between 78 and 400°K are used to determine the activation energy of the glide process at the beginning of deformation. The method used is that proposed by Conrad and Wiedersich and improved by Schöck. The influence of deformation inhomogeneities, the strain-rate dependence (as observed by Schwink and Neuhäuser), and a possible variation of the pre-exponential factor in the Arrhenius equation are taken into account. As in previous, less detailed investigations, the characteristic value for the elementary process ΔG_0, varies with temperature suggesting the occurrence of dislocation obstacles of varying size. (auth)

42921 IRRADIATION OF ION EXCHANGE RESIN BY TRIGA-II REACTOR. Maruyama, Yoshiaki; Idenawa, Kazuhide; Manri, Teruo (Musashi Inst. of Tech., Kawasaki, Japan). Radioisotopes (Tokyo), 14: 374-6(Sept. 1965). (In Japanese).

Air-dry and wet cation exchange resins, Diaion SK #1, were irradiated in the H-, Li-, Mn-, Cd-, and Pb-forms by the TRIGA-II reactor at 100 kw and air-dry anion exchange resins, Diaion SA #100, were irradiated in I- and BO_3-forms. The exchange capacity losses of these resins were measured after irradiation and compared with those produced in the same resins by ^{60}Co γ irradiation. Ferrous and cerric dosimeters were employed to measure the absorbed doses. The exchange capacity losses of the H-, Mn-, and I-form resins by the reactor irradiation were in agreement with those obtained in the same form resins by the ^{60}Co γ irradiation. Their values of H-, Mn-, and I-form resins by reactor irradiation were 13.5, 10.8, and 27.6%, respectively at 3.3×10^5 R. In the case of Cd-, Li-, and BO_3-form resins attaching the elements which have large cross sections with thermal neutron or emit heavy charged particles at the moment of neutron capture, the damage of the resins by the reactor irradiation was larger than that obtained in the same form resins by ^{60}Co γ irradiation. Their values of Cd-, Li-, and BO_3-form resins by reactor irradiation were 18.0, 33.8, and 43.8%, respectively at 3.3×10^5 R. Also the radiation damage of resins immersed in water or 3 N acetic acid solution was larger than that obtained in the air-dry resins by reactor or ^{60}Co γ irradiation. (auth)

42922 THE STRUCTURE OF GRAPHITE AND ITS ALTERATIONS IN A NUCLEAR REACTOR. Oberlin, Michel. Sci. Progr.-Nature, No. 3360, 122-8(Apr. 1965). (In French).

A review is given of the use of graphite in nuclear reactors and its modifications resulting from irradiation. The processes of graphitization are indicated and the industrial processing of graphite for various uses is described. The properties of graphite that make it of value as a moderator are described and the effects of neutrons on it are discussed. The effects of Wigner energy and the annealing of irradiated graphite to partially reduce the Wigner energy are summarized. (J.S.R.)

42923 THE BOMBARDMENT OF $A^{III}B^{V}$ COMPOUNDS WITH ELECTRONS. Baeuerlein, Rudolf. Siemens-Z., 39: 442-6(May 1965). (In German).

By bombarding barrier-layer elements of various A(III)B(V) compounds (GaAs, InP, InAs) with fast electrons, it was possible to determine the energy required to displace an atom from its position in the crystal lattice. In the case of InAs, a study was also made of the healing of such lattice disturbances by heat treatment of the crystal. By bombardment with electron pulses having an extremely short rise time, it was also possible to measure directly the very short life of charge carriers in A(III)B(V) compounds. (auth)

METEOROLOGY

See also GEOLOGY AND MINERALOGY — Site Survey and Selection.

42924 (BNWL–77) THE CALCULATION OF PRECIPITATION SCAVENGING. Engelmann, R. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). July 1965. Contract AT(45-1)-1830. 36p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Work in precipitation scavenging is reviewed as a guide to quantitative predictions. Collection efficiencies, washout coefficients for particles and gases, rain spectra, and washout by snow are discussed, and values given. Extensive "area within a washout isopleth" charts are shown for three atmospheric stabilities and several washout coefficients. (auth)

PHYSICS

General

42925 (JINR-P-2256) ISP'TANIE MODELEI GAZORAZRYADNOGO PREOBRAZOVATELYA IZOBRAZHENIYA. (Test of Models of a Gas Discharge Transformer of the Image). Gromova, I. I.; Peter, G.; Pisarev, A. F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1965. 11p. Dep. mn.

A possibility is considered of magnifying the light image in a gas discharge transformer. The device has two gaps: the photocathode–control grid and grid–anode. The second of them is filled with dielectric capillaries. In the first gap the photoelectrons are controlled, in the second gap–the image is magnified due to a luminescence of the gas discharge. It is established that at the neon pressure of 0.6 kg/m^2 the device magnifies the image satisfactorily. (auth)

42926 (NASA-SP-3018) CHARTS FOR EQUILIBRIUM AND FROZEN FLOWS ACROSS PLANE SHOCK WAVES IN CARBON DIOXIDE. Simcox, Craig D.; Peterson, Victor L. (National Aeronautics and Space Administration, Moffett Field, Calif. Ames Research Center). 1965. 129p. CFSTI $1.00 cy, $1.00 mn.

The properties across a number of types of shock waves common in engineering applications are calculated. The shocks include the normal and oblique waves used for estimating aerodynamic performance of bodies in flight, and the incident, standing, and reflected normal shock waves used for evaluating facility performance and for interpreting the results of experiments performed therein. The flow is assumed to be in equilibrium and the chemistry to be frozen with molecular vibrations either not excited or fully excited. Results are presented in graphical form for ambient pressures ranging from 10^{-7} to 10 atmospheres and for speeds ranging from 1 to 16 km/sec. (auth)

42927 (NP-15281) ANNUAL REPORT, 1964. (European Organization for Nuclear Research, Geneva (Switzerland)). 174p. Dep. mn.

Development during 1964 is reported on the following areas: proton synchrotron, synchrocyclotron, nuclear physics, track chambers, data handling, theoretical studies, nuclear physics apparatus, accelerator research, site and building, finance, personnel, health physics group, general safety group, central services, and a list of CERN publications, reprints, lectures, and seminars are presented. (M.O.W.)

42928 (NP-15290) AN ELEMENTARY NUMERICAL TREATMENT OF THE BOLTZMANN EQUATION FOR A SIMPLE GAS WITH PARTICULAR ATTENTION TO WALL INTERACTION. Report No. 17. Elrod, Harold G. (Columbia Univ., New York. Plasma Lab.). May 1965. Contract AF49(638)-1254. 45p.

A numerical method is described for dividing the phase space for a simple gas, in order to provide a link between the mean-free-path Maxwell analysis of transport properties of gases and the mathematical Chapman-Enskog treatment. It is noted that the method described may be more accurate than the Chapman-Enskog results near walls. (T.F.H.)

42929 (ORNL-TM-1105) TRANSITION RADIATION AND LOW-ENERGY BREMSSTRAHLUNG. Howe, Harry James Jr. (Oak Ridge National Lab., Tenn.). Aug. 1965. Contract W-7405-eng-26. 119p. Dep. mn; CFSTI $4.00 cy, $0.75 mn.

Thesis submitted to Vanderbilt Univ., Nashville.

A theoretical determination was made of the number distribution of photons emitted from a semi-infinite dielectric slab irradiated with electrons at an arbitrary angle of incidence. Theoretical spectra were generated for plane foils of copper, silver, and gold irradiated by electrons at normal incidence and were compared with available experimental data. Numerical theoretical results corresponding to the electron irradiation of plane foils of silver at various angles of electron incidence are presented. An intense "peaking" of the emitted radiation around the wavelength $\lambda = 3230$ Å was noted as the electron approached grazing incidence. The E^{-1} energy dependence of this radiation identified it as bremsstrahlung. Comparison of these results with recent experimental data shows fair agreement, but further work is necessary before conclusive interpretation can be made. (auth)

42930 (SC-R-65-889) ELECTROMAGNETIC WAVE PROPAGATION IN MEDIA OF PERIODICALLY TIME-VARYING PERMITTIVITY. Holberg, Dieter Ernst (New Mexico State Univ., University Park). Jan. 1965. Contract AT(29-1)-789. 152p. Dep. mn; CFSTI $5.00 cy, $1.00 mn.

Sandia Corp. Monograph.

The propagation of electromagnetic plane waves in a nonconducting, charge-free medium having a periodically time-varying permittivity given by $\epsilon(t) = \epsilon/(1 - A\cos Bt)$, where A and B are constants, is studied. The wave equation for the electric displacement can be separated into Mathieu's equation for the time dependence and Helmholtz' equation for the space dependence of the field. The properties and computational techniques of Mathieu functions are reviewed. It is found that the propagated waves may vary periodically or exponentially in time. A separate, independent approach to the problem is carried by use of partial difference equations. (T.F.H.)

42931 (ORNL-tr-681) ON THE THEORY OF THE DIFFUSION OF RESONANCE RADIATION. Biberman, L. M. Translated for Oak Ridge National Lab., Tenn. from Zh. Eksperim. i Teor. Fiz. 17: 416-26(1947). 18p. Dep. mn; CFSTI $1.00 cy, $0.50 mn; JCL $1.60 fs, $0.80 mf.

The qualitative differences are pointed out between radiation diffusion and particulate diffusion. It is shown that the differential equation of diffusion does not provide an adequate description of this phenomenon. An integral equation is obtained which describes the diffusion of resonance radiation through a layer of an absorbing gas. The equation is solved by approximate methods for the case of the Doppler line. The distribution of excited atoms is obtained as a function of the coordinates, the optical density, and extinction. By analyzing the results of the experiments of Zemansky and Bates, the effective cross sections are obtained for the extinction of the mercury radiation of 2537 Å by H_2, O_2, and N_2 molecules. (auth)

42932 THE NON-UNIFORM PISTON-DRIVEN MAGNETOHYDRODYNAMIC SHOCK WAVE. Gundersen, Roy M. (Univ. of Wisconsin, Milwaukee). Appl. Sci. Res., Sect. B, 11: 461-4(1964–1965).

The effects of small variations in cross-sectional area and piston velocity on the propagation of a shock wave into a duct are considered. The motion of the perfectly conducting fluid is subjected to a transverse magnetic field. In particular an expression for the pressure perturbation behind the shock was derived. (auth)

42933 ON A SYMMETRIC MOTION IN RESPECT TO THE AXIS OF A VISCOUS INCOMPRESSIBLE FLUID IN MAGNETOHYDRODYNAMICS: CASE IN WHICH THE MOTION OCCURS AROUND THE AXIS. Mattei, Giulio. Atti Accad. Sci. Torino: I. Classe Sci. Fis., Mat. Nat., 99: 637-53(1964-65). (In Italian).

The symmetrical motion of a viscous incompressible fluid around the axis is examined. The differential equations characterizing the problem are presented. The equations relative to the case in which the linear approximation is valid are studied, and the solutions of significant physical note are indicated. The non-viscous fluid is examined in particular. In this approximation, the two MFD

motions in the median plane and for coaxial circumference are independent of each other. The problem in the case in which the magnetic induction vector is parallel at all points to the velocity vector is then examined. The distribution of the system of total forces, both mechanical and magnetic, is studied. Two examples are given in conclusion. (J.S.R.)

42934 ENERGY AND DISPERSION IN ELECTROMAGNETIC SYSTEMS. Smith, W. E. (Univ. of New South Wales, Kensington). Australian J. Phys., 18: 287-95 (Aug. 1965).

The total average electromagnetic energy of a loss-free system is expressed in terms of the frequency dependence of the fields on an arbitrary mathematical surface enclosing the system. By introducing scattering, admittance, and impedance matrices the surface integral is reduced and the energy written as quadratic forms involving the frequency derivatives of these matrices. The arguments are of sufficient generality to apply in the presence of inhomogeneous, dispersive, and anisotropic or gyrotropic media. The requirement that the total energy be positive leads to important restrictions on the frequency dependence of the parameter matrices. The application to extensions of Foster's reactance theorem is discussed. (auth)

42935 MOMENT EQUATIONS WITH BOLTZMANN AND FOKKER-PLANCK COLLISION INTEGRALS. Sauer, K.; Wallis, G. (Heinrich-Hertz-Institut der Deutschen Akademie der Wissenschaften, Berlin). Beitr. Plasmaphysik, 5: 199-219(1965). (In German).

Some questions are discussed on the calculation of the collision integrals for the moment equations of the kinetic theory, using both the Boltzmann collision term and the Fokker-Planck form of this term, which is obtained by expanding the Boltzmann term in a Taylor series. It is shown that both forms give the same results for the collision integrals in the moment equation of the m^{th} order, if the Taylor expansion was carried out to the m^{th} order too. This equivalence does not depend on the law of interaction between the colliding particles. For strong deviations from equilibrium, the interaction therefore determines the convergence of the Fokker-Planck expansion and, with the equivalence derived in section 3 of this paper, the number of essential moments. Especially for the two extreme cases of Coulomb potential and rigid spheres we get the following consequences: In the first case (long range forces) the number of essential terms in the Fokker-Planck equation is two. Therefore the first two moment equations take account of the principal properties of the Boltzmann collision term in the kinetic equation. But for short-range forces and strong deviations from equilibrium, higher moment equations must not be neglected in the approximate solution of the Boltzmann equation. The integration in velocity space, needed for this moment method, is easily carried out with the integral superposition of Weitzsch for the distribution function. This was done by Suchy, using the whole Boltzmann term, for every interaction potential $U \sim r^{-p}$, $p > 0$. In the case of $p = 1$, however, the calculation employing the Fokker-Planck term becomes much simpler, since the Taylor series breaks off after the second term, and one may use the Rosenbluth-McDonald-Judd formula. (auth)

42936 THE GROUND STATE OF THE BOSE GAS. Robinson, Derek W. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Commun. Math. Phys., 1: 159-74(1965).

The mathematical formalism describing the Bose gas at zero temperature is analyzed with the aid of methods that have recently been successful in relativistic quantum field theory. First the spectrum conditions for an infinitely extended system are given, and the algebra of observables and the algebra of field operators are defined. General properties of states over these algebras are discussed, and theorems are given which connect the linked cluster property, translation invariance, and the purity of the states. It is proved that pure states over the algebra of observables have the property of factorizable off-diagonal long-range order. The class of quasi-free states is defined; and of these states, those which are translation invariant and possess the linked cluster property are analyzed. It is shown that this class of states contains a subclass of pure states of the Bogoliubov type and a subclass of states which are mixtures of non-translationally invariant pure states. The applications of these quasi-free states to the interacting Bose gas are summarized. (auth)

42937 ATTENUATION OF HOMOGENEOUS TURBULENCE IN A WEAKLY CONDUCTING LIQUID. Eliseev, B. V. Dokl. Akad. Nauk SSSR, 161: 560-2(Mar. 21, 1965). (In Russian).

The attenuation of homogeneous turbulence in a weakly conducting incompressible liquid situated in a homogeneous magnetic field, such that the average velocity of turbulent motion is equal to zero, is determined. The characteristic magnetic Reynolds number is assumed to be smaller than unity. The equation for the second moments is obtained in the usual fashion from the Navier-Stokes equation of motion. It is shown that all the correlations decrease in time like t^3, which is in accord with the results obtained by others in less general cases. It is therefore concluded that the asymptotic law of degeneracy of turbulence in magnetohydrodynamics, as in hydrodynamics, is universal and independent of the initial conditions. (ATD)

42938 LIMIT CASES OF THE PATH DISTRIBUTION OF PHOTONS EMERGING FROM THE THICK SCATTERING LAYER. Romanova, L. M. (Inst. of Physics of the Atmosphere, Academy of Sciences, USSR). Fiz. Atm. i Okeana, 1: 599-606(June 1965). (In Russian).

The photon paths distribution in the turbid medium may be calculated if the light intensity as the function of the parameter $\beta = \alpha/\sigma$ (α and σ—volume absorption and scattering coefficients) is known. It is shown that for the paths close to the distance from the nearest radiation source the photon paths distribution is determined with the light intensity in the case of the strong absorption. In the asymptotical case of very long paths this distribution is determined with the light intensity for small β (weak absorption). The photon paths distribution is calculated for the light reflected from the semi-infinite layer with the spherical and highly elongated scattering indicatrices. (auth)

42939 OBSERVATION OF FOCUSED ELECTRON BEAMS IN A METAL. Sharvin, Yu. V.; Fisher, L. M. (Inst. of Physics Problems, Academy of Sciences, USSR). JETP Letters (USSR)(English Transl.), 1: 152-3(June 1, 1965).

The focusing of an electron beam in a single-crystal plate of tin by a longitudinal magnetic field was observed experimentally. (D.C.W.)

42940 STRUCTURE OF FERMION DENSITY MATRICES. II. ANTISYMMETRIZED GEMINAL POWERS. Coleman, A. J. (Queen's Univ., Kingston, Ont.). J. Math. Phys. (N. Y.), 6: 1425-31(Sept. 1965).

Functions which can be expressed as an antisymmetrized power of a single two-particle function (a geminal) occur in the BCS ansatz. They constitute a comparatively tractable generalization of a single Slater determinant. The second-order reduced density matrix and bounds on its eigenvalues are obtained for the most general such antisymmetrized geminal power (AGP). These eigenvalues are physically of great importance, being analogs, in an analysis of the wave function into pair states, of the one-particle occupation numbers of the independent-particle model. A necessary and sufficient condition is given that an alleged first-order reduced density matrix be derivable from an N-particle AGP function. It is shown that only for exceptional functions (called extreme) is the generating geminal of the AGP function an eigenfunction of the 2-matrix. The extreme 2-matrix is diagonalized explicitly and provides a vivid example of the fact that one-particle occupation numbers alone are unable to convey certain information of decisive significance about the wave function. The extreme 2-matrix satisfies the assumption basic to current theories of superconductivity. (auth)

42941 REDUCED DENSITY MATRICES OF QUANTUM GASES. III. HARD-CORE POTENTIALS. Ginibre, Jean (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). J. Math. Phys. (N. Y.), 6: 1432-? (Sept. 1965).

In two previous papers, the reduced density matrices of quantum gases, in the grand canonical formalism and for suitably restricted interaction potentials, were shown to be analytic vector-valued functions of the activity in a neighborhood of the origin, to tend in some sense to well-defined limits as the volume of the system becomes infinite, and to satisfy a cluster decomposition property. The same results are extended here by the same methods to a wider class of potentials, including hard-core potentials, and allowing attractive interactions, which were excluded previously. (auth)

42942 CONVERGENCE OF THE CHAPMAN–ENSKOG EXPANSION FOR THE LINEARIZED BOLTZMANN EQUATION. McLennan, James A. (Lehigh Univ., Bethlehem, Penna.). Phys. Fluids, 8: 1580-4(Sept. 1965).

The convergence of the Chapman–Enskog expansion for the linearized Boltzmann equation is discussed, using methods of perturbation theory. It is shown that, under suitable conditions, a normal solution exists and has a convergent perturbation expansion, for processes which vary sufficiently slowly. Furthermore, the normal solution dominates all other solutions with the passage of time. The necessary conditions are such as to make the total scattering cross section nonvanishing at high energy. This is the case in classical theory for any cutoff potential and in quantum theory for hard-core potentials. In contrast, if the cross section vanishes at high energy, then there is no normal solution with similar properties. (auth)

42943 SPECTRUM OF STATIONARY HOMOGENEOUS MAGNETOHYDRODYNAMIC TURBULENCE. Tchen, C. M. (National Bureau of Standards, Washington, D. C.). Phys. Fluids, 8: 1659-67(Sept. 1965).

The equations determining the spectral distributions of kinetic and magnetic energies are formulated from the magnetohydrodynamic equations. The turbulence is assumed to be incompressible, homogeneous, isotropic, and stationary. The nonlinear terms of the equations, responsible for the transfer and exchange of energies, are determined using the concept of turbulent mixing, as a generalization of the Heisenberg theory. For this purpose, a theory of mixing of waves is proposed. Although empirical, it helps to give some foundation to the Heisenberg hypothesis of a turbulent viscosity and to clarify the mechanism of interactions between the turbulence and the magnetic field. (auth)

42944 GROWTH AND EXCITATION OF ELECTROHYDRODYNAMIC SURFACE WAVES. Crowley, Joseph M. (Massachusetts Inst. of Tech., Cambridge). Phys. Fluids, 8: 1668-76(Sept. 1965).

Waves on the surface of a capillary liquid jet stressed by a steadily applied electric field will grow in space if the velocity of the jet is supercapillary. Experimental measurements of this growth rate confirm previous theoretical discussions. The excitation of these waves by means of an applied electric field with steady and time-varying components is also studied theoretically, and the frequency response is found to depend on both the shape of the electrodes and on the convective growth of the waves due to the steady component of the field. The predictions of this theory are confirmed by measurements on a water jet. (auth)

42945 HYDROMAGNETIC MOMENTUM SOURCE. Ranger, K. B. (Univ. of Toronto). Phys. Fluids, 8: 1747-8(Sept. 1965).

Starting from the equations for the steady flow of an incompressible viscous fluid in a magnetic field, it is shown that the momentum transfer across a sphere s is a constant over s. The flow can be described as a momentum source or the motion caused by the continuous application of a point force at the origin along the axis of symmetry. (D.C.W.)

42946 SUPPRESSION AT HIGH TEMPERATURE OF EFFECTS DUE TO STATISTICS IN THE SECOND VIRIAL COEFFICIENT OF A REAL GAS. Larsen, Sigurd Yves (National Bureau of Standards, Washington, D. C.); Killpatrick, John E.; Lieb, Elliot H.; Jordan, Harry F. Phys. Rev., 140: A129-30(Oct. 4, 1965). (LA-DC-7019).

It is shown that the repulsive core present in realistic two-body potentials and in hard spheres leads to the rapid suppression of the effects of statistics in the second virial coefficient, except at very low temperatures. For hard spheres, an upper bound is obtained which goes down exponentially with temperature when the latter becomes large. (auth)

42947 CONDUCTIVITY OF A DEGENERATE ELECTRON GAS. Suffczynski, Maciej (Michigan State Univ., East Lansing). Phys. Rev., 140: A147-51(Oct. 4, 1965).

The high-frequency, wave-vector-dependent conductivity of a degenerate electron gas near equilibrium is calculated by taking into account the zero-, the first-, and two of the second-order diagrams in the effective interparticle interaction. Approximate formulas are derived for the case when the frequency ω of the electromagnetic wave is high and its wave vector k is small, i.e., $\omega \gg kp_F/m$, where p_F is the Fermi momentum of the electron gas. (auth)

42948 COULOMB CORRELATIONS IN INHOMOGENEOUS MANY-PARTICLE SYSTEMS. Ichimaru, Setsuo (Univ. of Illinois, Urbana). Phys. Rev., 140: B226-35 (Oct. 11, 1965).

The fluctuation-dissipation theorem is applied to the study of the pair correlation functions of the system containing charged particles which is not invariant under spatial translation. The results are expressed in terms of the longitudinal response functions and involve correlation functions which depend only on screened short-range Coulomb interactions. It is shown that the expression for the density-density correlation function, in the case of the electron gas, implies the principle of superposition of dressed particles (the bare particles plus their associated screening clouds); for the calculations of the correlation functions, the dressed particles may be superposed without further consideration of the long-range parts of Coulomb interactions. Similar reductions are carried out for the various correlation functions in the electron-ion system, and the superposition principle is confirmed. A possible extension of the results to a nonequilibrium stationary system is suggested and discussed. The interrelationship among various longitudinal response functions, which is characteristic of the inhomogeneous system, is discussed and clarified. Simplifications arising from the homogeneity and discussions from diagrammatic considerations are given in appendices. (auth)

42949 PROPOSAL FOR A SOURCE OF POLARIZED NEGATIVE HYDROGEN IONS. Donnally, Bailey B.; Sawyer, William (Lake Forest College, Ill.). Phys. Rev. Letters, 15: 439-41(Sept. 6, 1965).

A proposal for a polarized negative hydrogen-ion source is: to produce H(2s) by the reaction $H^+ + Cs \rightarrow H(2s) + Cs^+$, polarize the H(2s) atoms by selectively quenching the $m = -1/2$ states in a 575-G magnetic field, and selectively attach an electron to the H(2s) atom in a weak magnetic field. This sequence of processes would yield negative ions with a nuclear polarization of 50%. If a radio-frequency transition is interposed between the polarization and the electron attaching then a nuclear polarization of 100% could be obtained. The process of selectively attaching an electron to the H(2s) atom is reported. A charge-exchange process was sought by which metastable hydrogen atoms could pick up an electron, forming a negative hydrogen ion. Protons produced in an electron-bombardment ion source were separated from other ions by a 60° sector magnet and were directed through a one-inch-long cavity containing cesium in equilibrium with its vapor. Emerging from this cell were protons and negative hydrogen ions as well as neutral components. It is considered that a polarized negative-ion source could probably be built with intensities in the microampere range. (J.F.P.)

42950 EFFECT OF THE PHONON FIELD ON THE PLASMA FREQUENCY OF AN ELECTRON GAS FOR NON-ZERO TEMPERATURES. Corciovel, A.; Grecu, D.; Babcenco, A. (Inst. for Atomic Physics, Bucharest). Phys. Status Solidi, 11: 67-80(Sept. 1, 1965).

The equation of motion for the one-electron density matrix of an electron gas which interacts with a phonon field is considered for non-zero temperatures. It is shown that the shifting of the plasma frequency is due, besides the known induced random-phase-approximation term, to a second term produced by the thermal equilibrium of the phonons. This second term is discussed, and the corresponding dispersion relation for the plasma frequency is obtained for low and high temperatures. (auth)

42951 RELATIVISTIC EFFECTS IN STATISTICAL HYDRODYNAMICS. De Gottal, Ph.; Prigogine, I. (Universite, Brussels). Physica, 31: 677-87(May 1965).

A classical relativistic electron gas is considered, and the effect of the particles' interaction on the macroscopic behavior of the system is investigated. It is shown that due to the nonvalidity of the principle of action and reaction the field surrounding the particles acts as a reservoir of momentum and energy for the matter; new kinds of motion are permitted due to a source term appearing in the equation of hydrodynamics. (auth)

42952 ON THE THEORY OF CLASSICAL FLUIDS. IV. Verlet, L. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Physica, 31: 959-66(June 1965).

New integral equations are derived which should correct the Percus-Yevick and the hypernetted chain equation at high density. This derivation uses Percus's method. It is also shown how these equations can be effectively solved. A first test of the fitness of such equations is provided by the calculation of the fifth virial coefficient in the case of purely repulsive potentials. (J.F.P.)

42953 ON THE CRITERION OF MAGNETOGRAVITATIONAL INSTABILITY OF A VISCOUS FLUID MEDIUM WITH FINITE ELECTRICAL CONDUCTIBILITY IN UNIFORM ROTATION MOTION. Vasiu, M. Studia Univ. Babes-Bolyai, Ser. Math.-Phys., No. 1, 123-38(1964).

The case of magnetogravitational instability of an infinite homogeneous, completely ionized, compressible, and viscous fluid in uniform rotation motion is studied. For the sake of simplification, the thermal conductivity and radiation transfer processes as well as the electric displacement current in the fluid are neglected. The results obtained generalize those of Pacholczyk and Stodolkiewicz, who studied the magnetogravitational instability of a non-viscous fluid with finite electric conductivity and the magnetogravitational instability of a viscous fluid with infinite electric conductivity. An appendix treats the determination of the magnetogravitational instability criterion of a totally ionized compressible viscous fluid with infinite electric conductivity in the presence of an electric displacement current, the fluid being in uniform rotation motion. The respective medium is considered as infinite and homogeneous subject to the action of a uniform magnetic field and to that of its own gravitational field. It is shown that the presence of the displacement current does not affect the magnetogravitational instability criterion obtained for such a fluid in the case of the absence of current. (Rumanian Sci. Abstr., Vol. I, Oct. 1964).

42954 STATISTICAL MOTION OF ISOLATED SYSTEM AND ENTROPY INCREASE. Schloegl, F.; Stahl, A.; Bausch, R. (Technische Hochschule, Aachen). Z. Physik, 187: 290-304(1965). (In German).

The most general dynamical laws describing the evolution of isolated systems are discussed. These may be described by linear transformations which in classical physics apply to probability distributions and to density operators in quantum physics. Entropy does not decrease if and only if the equipartition is invariant under the dynamical transformation. This invariance follows in a natural way for isolated systems from the interpretation of entropy as lack of information. If entropy is conserved for quantum systems, the dynamical transformation becomes a unitary transformation generated by a Hamiltonian, whereas for classical systems a generalized form of Liouville's equation may be derived. (auth)

42955 FIZIKA UDARNYKH VOLN I VYSOKO TEMPERATURNYKH GIDRODINAMICHESKIKH YAVLENII. (Physics of Shock Waves and High-Temperature Hydrodynamic Phenomena). Zel'dovich, Ya. B.; Raizer, Yu. P. Moscow, State Publishing House of Physico-Mathematical Literature, 1963. 632p.

A systematic and theoretical presentation is given of topics in gas dynamics and hydrodynamics. Discussions are presented of the elements of gasodynamics and the classic theory of shock waves, thermal radiation and radiant heat exchange in a medium, thermodynamic properties of gases at high temperatures, shock tubes, absorption and emission of radiation in gases at high temperatures, rates of relaxation processes in gases, structure of the shock-wave front in gases, physical and chemical kinetics in hydrodynamic processes, optical phenomena in shock waves and during strong explosions in air, thermal waves, shock waves in solids, and some self-similar processes in gas dynamics. 426 references. (M.J.T.)

42956 TEORIYA NEPOLNYKH TSILINDRICHESKIKH FUNKTSII I IKH PRILOZHENIYA. (The Theory of Incomplete Cylindrical Functions and Their Uses). Agrest, M. M.; Maksimov, M. Z. Moscow, Atomizdat, 1965. 351p.

The concept of incomplete cylindrical functions is discussed. An analysis is made of the use of incomplete cylindrical functions in practical problems related to charged particle motion in magnetic and electric fields, reactions of particles with atomic nuclei, transition processes in electric circuits, and calculations for nuclear reactors. Brief tables of Bessel functions of zero and first order are included. (R.V.J.)

42957 APPLICATION OF THE BENEDICT-WEBB-RUBIN EQUATION OF STATE TO ARGON. Zudkevitch, David; Kaufmann, Thomas G. (Esso Research and Engineering Co., Florham Park, N. J.). 28p. (CONF-650559-3). Gmelin, AED-CONF-65-086-10.

From American Inst. of Chemical Engineers, 56th National Meeting, San Francisco.

The coefficients of the Benedict-Webb-Rubin equation of state have been developed for argon. Employing these coefficients, the volumetric behavior of argon has been predicted with an average deviation of 0.241% for 597 smoothed and experimental data points in the superheated region. At temperatures below the critical two sets of C_0's, one for the liquid and one for the vapor, were needed to relate the vapor pressure to the densities of saturated argon. Using the experimental data of Holst and Wilson the reliability of the BWR coefficients were demonstrated by predicting the phase behavior of the argon-nitrogen system down to -326°F. Further improvement of the results was obtained when another set of C_0's were developed by equating the pure component vapor and liquid fugacities along the vapor pressure curves. In calculating enthalpy deviations from the ideal state the original BWR expression was modified to include explicitly the temperature dependence of the coefficient C_0. Predicted values of enthalpy deviations obtained with this expression showed good agreement with values from Din's compilation. (auth)

42958 THERMODYNAMIC CONSISTENCY TESTS FOR SOLID-LIQUID EQUILIBRIA. Null, Harold R. (Monsanto Co., St. Louis). 21p. (CONF-650559-5). Gmelin, AED-CONF-65-086-22.

From American Inst. of Chemical Engineers, 56th National Meeting, San Francisco.

The technique of testing the validity of phase equilibria by applying thermodynamic consistency tests is highly developed for vapor-liquid equilibria. The application

to solid-liquid equilibria, however, has been developed hardly at all. The problems associated with thermodynamic consistency tests are discussed and a new technique for evaluating the validity of experimental data is developed. Several possible test equations are presented, and applied to test the consistency of three sets of solid-liquid equilibrium data. (auth)

Accelerators

Refer also to abstracts 42673, 42682, and 43052.

42959 (BNL-9420) PRELIMINARY WORK ON THE SLOW EXTRACTED PROTON BEAM. Barton, M. Q. (Brookhaven National Lab., Upton, N. Y.). July 20, 1965. Contract AT-30-2-GEN-16. 16p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

A variety of computer studies were undertaken to investigate the possibility of using a third-integral nonlinear resonance as a mechanism for obtaining a slow external beam at the AGS. Some of the results of these studies are summarized. Certain experiments are reported which are suggested by the above results. (M.O.W.)

42960 (DESY-65/4) INTENSITATSUNABHANGIGE LAGEMESSUNG BEIM GEPULSTEN ELEKTRONEN-STRAHL. (Intensity Independent Position Measurement of Pulsed Electron Beams). Swars, M. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). May 1965. 40p. Dep. mn.

The method for inductive measurement of the electron beam position which is described uses two pick-up coils which, in connection with a pair of logarithmic amplifiers, effect an indication independent of the beam intensity. Formulas about the terminal voltage of the coils are explained. Hence it follows that ferrite core coils are better than air core coils. An analysis of the noise behavior shows the superiority of a grid-grounded preamplifier to a cathode-grounded one. (auth)

42961 (JINR-P-2266) O VYBORE REZHIMA INZHETSII V SINKHROFAZOTRON DLYA POLUCHENIYA MAKSIMAL'NOI INTENSIVNOSTI USKORENNYKH PROTONOV. (On a Choice of the Synchrophasotron Injection Regime for Obtaining the Maximal Intensity of the Accelerated Protons). Kuznetsov, A. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1965. 7p. Dep. mn.

A qualitative consideration of the maximal possible number of particles in the synchrophasotron chamber is carried out under the conditions when the intrinsic forces of the beam are comparable with the external focusing ones. A possible effect of the resonances during the acceleration is estimated. A rational injection regime is suggested which provides the minimal losses and maximal possible intensity of the accelerated beam. (auth)

42962 (NIRL/R/84) MACHINE PHYSICS EXPERIMENTS ON THE NIMROD INJECTOR. West, N. D. (National Inst. for Research in Nuclear Science, Chilton (England). Rutherford High Energy Lab.). Mar. 1965. 42p. Dep. mn; BIS $1.20; HMSO 6s.

The results of some experiments on the Nimrod 15 Mev proton linac injector are described. The object of the experiments was to investigate the characteristics of the proton beam and to determine optimum operating conditions for the injector equipment. (auth)

42963 (NIRL/R/97) NIMROD COMMISSIONING LEADING TO THE FIRST 7 Gev OPERATION. Billinge, R.; Boyd, W.; Gray, D. A.; Hobbis, L. C. W.; Mullett, L. B.; Wilde, P. (National Inst. for Research in Nuclear Science, Chilton (England). Rutherford High Energy Lab.). Mar. 1965. 13p. Dep. mn; BIS $0.80; HMSO 4s.

A description is given of the final stages of commissioning the 7 Bev proton synchrotron "Nimrod," from the time when construction had reached the stage where acceleration could be attempted to the successful operation at design energy. The account is taken from the experimental log and the conclusions recorded are those drawn at the time. (auth)

42964 (ORNL-3782, pp 144-52) SUPPORT FOR THE HIGH-VOLTAGE ACCELERATOR PROGRAM. (Oak Ridge National Lab., Tenn.).

Development of an accelerator irradiation sample changer and pulse-routing circuit is reported. Developmental work is also reported on gas targets for elastic and inelastic neutron scattering, duoplasmatron ion sources and lens-pulsers, adjustable repetition-rate ion source pulsers, vacuum pumps, and viewer cups for ORNL Van de Graaff accelerator. Information is included on nanosecond pulsing for Van de Graaff accelerators, pulsed duoplasmatron terminal for ORNL 5-Mv Van de Graaff accelerator, instrumentation for fission fragment energy correlation experiments, and systems for correlated energy and time-of-flight measurements of fission fragments using semiconductor detectors. (J.R.D.)

42965 (PPAD-2137-547) DESIGN OF A TRANSPORT SYSTEM FOR HIGH INTENSITY BEAMS. Passner, A.; Powers, R.; Catura, R. C. (Princeton-Pennsylvania Accelerator, Princeton, N. J.). May 10, 1965. Contract AT(30-1)-2137. 13p. (CONF-650306-60). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Particle Accelerator Conference, Washington, D. C.

A system was designed which is calculated to be capable of transporting up to 50 mamp of 3-Mev protons a distance of 75 feet. The beam is contained within a radius of one inch and its phase plot is optimally matched to the acceptance of the Synchrotron. This phase matching is accomplished over a wide range of beam currents by varying the excitation of the final quadrupole doublet. A computer program written to calculate the dynamics of the beam is described and some of its characteristics are discussed. (auth)

42966 (UCRL-16267) THE RADIATION FIELD OBSERVED AROUND HIGH-ENERGY NUCLEAR ACCELERATORS. Thomas, Ralph H. (Lawrence Radiation Lab., Univ of California, Berkeley). July 29, 1965. Contract W-7405-eng-48. 22p. (CONF-650907-2). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From 11th International Congress of Radiology, Rome.

The radiation field observed outside of well-shielded proton accelerators with energies above 1 Bev is described. The measured-dose composition from this field is explained in terms of the energy spectrum of particles emerging from the shielding. By extrapolation of this spectrum to higher energies, the dose delivered to individuals outside the shielding of future high-energy accelerators, is predicted as a function of particle energy. It is suggested that dosimetry techniques for measuring protons and neutrons up to about 1 Bev should be developed for these new accelerators. (auth)

42967 APPLICATIONS OF ACCELERATING FIELD FOCUSING AT THE INITIAL PART OF LINEAR ION ACCELERATOR. Teplyakov, V. A.; Ermakov, S. M.; Makarov, A. I.; Gendel, Yu. G.; Krasnovskii, V. I.; Shembel, B. K. Pribory i Tekhn. Eksperim., No. 4, 26-9(July-Aug. 1965). (In Russian).

The initial part of the accelerator with injection energy of 50 kev is described. By comparison of the photon spectra at the outlet of accelerators with drift tubes with channels of rectangular and other cross sections, it was shown that focusing by accelerating fields is effective. (tr-auth)

42968 CALCULATION OF GAP PARAMETERS FOR FOCUSING BY ACCELERATING FIELD. Mal'tsev, A. P.; Teplyakov, V. A. Pribory i Tekhn. Eksperim., No. 4, 29-31(July-Aug. 1965). (In Russian).

The analytical expressions of the electric parameters of the gap for focusing by accelerating fields was found across its geometric dimensions by means of the determination of the electrostatic charge with approximate assignment of the boundary conditions. A comparison was made with experimental data on electrolytic baths. (tr-auth)

42969 HIGH-FREQUENCY ION SOURCE IN STRONG MAGNETIC FIELD. Ad'yasevich, B. P.; Aleshin, V. D.; Smirnov, G. V. (Inst. of Atomic Energy, Moscow). Pribory i Tekhn. Eksperim., No. 4, 32-5(July-Aug. 1965). (In Russian).

The results of the investigation of high frequency ion generators, developed for use on polarized ion sources, were reported. The ion generator works at frequencies of 10 BHz in strong constant magnetic fields H = 4200 Oe. The dependence of the ion current on the pressure in the discharge chamber and on the voltage of the magnetic field and the dependence of the mass spectra on the pressure in the discharge chamber were shown. (tr-auth)

42970 COMBINED WORK OF TWO BUBBLE CHAMBERS IN ONE ACCELERATION CYCLE OF 10-Gev SYNCHROPHASOTRON. Kazanskii, G. S.; Mikhailov, A. I.; Moroz, V. I. (Joint Inst. of Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 4, 39-42(July-Aug. 1965). (In Russian).

A method for the combination of two bubble chambers in one acceleration was described. The problems, combined with the stabilization of the given intensity level of the proton beam striking the target, were briefly described. The operational regime of two chambers with one acceleration cycle applied at the JINR synchrophasotron was described. (tr-auth)

42971 DESIGN OF A GAS TARGET FOR AN ELECTROSTATIC ACCELERATOR. Gorlov, G. V.; Kirillov, A. I.; Lebedeva, N. S. (Inst. of Nuclear Energy, Moscow). Pribory i Tekhn. Eksperim., No. 4, 221-2(July-Aug. 1965). (In Russian).

The construction of a gas target for an electrostatic generator is described. The use of a diaphragm pump makes possible the efficient cooling of the foil of the inlet aperture of the target and at the same time significantly increases the maximum of the current to the target. For thicknesses of the nickel foil of 1.35 mg/cm^2 and pressure of the deuterium in the target of 700 torr, the current attains 10 μamp at energies of 1.4 Mev. The target is simple in preparation and reliable in operation. (tr-auth)

42972 PHERMEX—A HIGH-CURRENT ELECTRON ACCELERATOR FOR USE IN DYNAMIC RADIOGRAPHY. Boyd, T. J. Jr.; Rogers, B. T.; Tesche, F. R.; Venable, Douglas (Los Alamos Scientific Lab., N. Mex.). Rev. Sci. Instr., 36: 1401-8(Oct. 1965). (LA-DC-7247).

A high-current, three-cavity, standing-wave linear electron accelerator (PHERMEX) was designed and built to produce a pulsed bremsstrahlung beam. This beam was desired for use in flash radiography of explosively driven metal configurations, as an aid in the study of shock-induced hydrodynamic phenomena. An unfocused beam exceeding 70 amp for 0.10 or 0.20 μsec is available, at a peak energy of about 20 Mev. A 20-amp beam for radiographic use, for the same time intervals and peak energy, is focused directly onto a tungsten target to form a 3 mm diam bremsstrahlung source. (auth)

Astrophysics and Cosmology

42973 (NEIC-RR-8) NUCLEAR ASTROPHYSICS. A BIBLIOGRAPHICAL SURVEY. PART I. Kuchowicz, B. (Nuclear Energy Information Center, Warsaw (Poland)). 1965. 89p. Dep.

An account is given on the historical line of development of the question of abundance of chemical elements in cosmic bodies (up from a chemical analysis of the Earth crust and meteorites to the spectroscopy of stellar atmospheres). A short survey of papers devoted to nuclear reactions in stars and stellar energy sources, stellar structure and evolution from the standpoint of nuclear reactions, solar system, novae and supernovae, and superdense stellar matter is presented. The problem of nucleosynthesis of chemical elements is outlined. Papers on other interesting problems of nuclear astrophysics—neutrino emission by stars, origin of cosmic radiation, radio and gamma astronomy and certain cosmological and cosmogonical questions are reviewed. A short list of the most important papers frequently quoted in papers on nuclear astrophysics is presented. (M.O.W.)

42974 (NEIC-RR-10) NUCLEAR ASTROPHYSICS. A BIBLIOGRAPHICAL SURVEY. PART III. Kuchowicz, B. (Nuclear Energy Information Center, Warsaw (Poland)). 1965. 123p. Dep.

A bibliography is presented, consisting of 821 references to material on astrophysical and cosmological areas of nuclear and elementary-particle physics. (T.F.H.)

42975 VIBRATIONAL STABILITY OF PURE HELIUM STARS. Boury, A.; Ledoux, P. (Universite, Liege). Ann. Astrophys., 28: 353-6(1965). (In French).

The recent models of Deinzer and Salpeter were used to calculate the stability of pure helium stars with respect to vibration; small corrections for degeneracy for masses less than 6 $M_\odot$ were neglected, as were convection and non-constant diffusion opacity models. For the model employed, the following values of $M/M_\odot$ give the corresponding values of D (destabilization) and S (stabilization): $\times 10^{39}$: 3.986, 3.068, 9.00; 6.588, 9.255, 11.0; 14.80, 32.26, 17.2; 32.10, 98.02, 28.0; 78.20, 299.3, 45.6. Thus S equals D when M equals M_{cr} for He, that is, 7-8 $M_\odot$. Hydrogen stars have a larger critical mass, 60-280 $M_\odot$, by various calculations. Instability with respect to further evolution of stars and the effects of further evolution on instability are also considered. The effective critical mass still remains at 7-8 $M_\odot$ in the principal sequence. Slight stabilizing effects in further evolution do not appreciably change this value, but the evolution is perturbed by radial oscillations. (BBB)

42976 MODELS OF MASSIVE STARS IN HOMOLOGOUS GRAVITATIONAL CONTRACTION. Meggitt, S. M. A. (Australian National Univ., Canberra). Australian J. Phys., 18: 297-302(Aug. 1965).

Nine models of homologously contracting, uniform composition stars were constructed for $\mu^2 M/M_\odot$ in the range 10–80. Apart from the two smallest models, all models have convective cores, the size of core increasing with the mass. The rate of contraction increases with mass up to $\mu^2 M/M_\odot = 32$ and decreases thereafter. One set of models covers all compositions. (auth)

42977 ABSOLUTE MEASURES OF STELLAR RADIATION. [PART] II. Willstrop, R. V. (Cambridge Observatories, Eng.). Mem. Roy. Astron. Soc., 69: 83-143 (1965).

A photoelectric spectrum-scanning photometer was built at the Cambridge Observatories. This was used, first in preliminary trials at the prime focus (f/4.5) of the Cambridge 36-in. reflector, for which it was specifically designed, and then at the Newtonian focus (f/4.85) of the Radcliffe 74-in. reflector. All the results quoted in this paper are from measurements made at Pretoria. The spectra of 215 stars, with spectral types from O_5 to M_4 and luminosity classes I to V, were scanned with 50-Å resolution from 3300 to 6900 Å. The intensities observed were corrected for atmospheric absorption, etc., and were normalized to give the absolute intensity, in cgs units, received outside the Earth's atmosphere from a star of the same spectral type and apparent magnitude V = 0.00. The normalization depends on the results of earlier work which covered the B and V spectral regions. The results presented cover the range 4000 to 6500 Å. (auth)

42978 SOLAR MAGNETIC FIELDS AND THEIR SIGNIFICANCE FOR GEOPHYSICS. Jaeger, F. W. Naturw. Rundschau, 18: 24(Jan. 1965). (In German).

Solar activity is discussed in terms of solar magnetic fields, together with the effects of solar events observed on the earth. Particle emission from active regions and radiations produced by the particles are considered, as well as their effects on the earth's atmosphere. (D.C.W.)

42979 SUPERDENSE STARS OF LARGE SIZE. Just, K. (Argonne National Lab., Ill.; Univ. of Arizona, Tucson). Nuovo Cimento (10), 39: 142-50(Sept. 1, 1965).

The recently asserted destruction of matter is avoided by postulating that under extreme pressures matter behaves like a gas of particles much heavier than nucleons, namely with masses up to the natural unit defined by gravity. (auth)

42980 X-RAYS FROM VAN ALLEN BELTS AROUND A MAGNETIC NEUTRON STAR. de Sabbata, V.; Gualdi, C. (Istituto Nazionale di Fisica Nucleare, Bologna). Nuovo Cimento (10), 39: 151-6(Sept. 1, 1965).

The possibility is considered that the experimentally observed cosmic x-ray sources are produced by synchrotron emission from belts of relativistic electrons trapped in the magnetic field of neutron stars analogous to the Van Allen belts. The possibility of producing high-energy electrons by violent events is examined, taking also into account the McCrea theory of continuous creation. (auth)

42981 ON THE MAGNETIC FIELD IN THE GALACTIC HALO. Sironi, G. (Universita, Milan). Nuovo Cimento (10), 39: 372-6(Sept. 1, 1965).

The average magnetic field in the galactic halo is estimated by combining the frequency spectrum of the galactic nonthermal radio noise and the energy spectrum of the electrons producing the synchrotron radiation, using new experimental results on both the synchrotron radiospectrum and the cosmic-ray electrons. The average field in the galactic disk is calculated from the result. (M.J.T.)

42982 POSSIBILITY OF A RELATIVISTIC EXPLANATION FOR STELLAR MAGNETIC FIELDS. Carr, W. J. Jr. (Westinghouse Electric Corp., Pittsburgh). Phys. Rev., 140: B236-?(Oct. 11, 1965).

It is suggested that the magnetic fields observed in the stars result from the role of the field in producing hydrostatic equilibrium when general-relativistic effects are included in the equations of magnetohydrodynamics. The effect of relativity, for a nonuniformly rotating body such as the sun, is to introduce a force with symmetry which cannot be balanced by a pressure gradient or by the gradient of a gravitational potential. If the average magnetic force is equated to the average relativistic force, the value obtained for the magnetic field is in good agreement with observation. (auth)

42983 GRAVITATIONAL RADIATION IN HOMOGENEOUS COSMOLOGICAL MODELS WITH SPACE-SECTIONS OF CONSTANT NEGATIVE CURVATURE. Krishna Rao, J.; Vaidya, P. C. (Gujarat Univ., Ahmedabad, India). Proc. Cambridge Phil. Soc., 61: 763-5(July 1965).

The propagation of type N gravitational radiation in homogeneous cosmological models with space-sections of constant negative curvature is considered. It is found that the propagation of radiation distorts the isotropy of the fluid pressure in the models permanently. (auth)

42984 NATURE OF THE RADIO EMISSION OF FLARE STARS. Shlysh, V. I. (Shternberg State Astronomical Inst., USSR). Soviet Astron. AJ (English Transl.), 8: 830-2(May-June 1965).

Translated from Astron. Zh., 41: 1038-41(Nov.-Dec. 1964).

The radio emission mechanism of UV Cet type flare stars is discussed. It is shown that synchrotron radiation of relativistic electrons with a power-law energy spectrum can not explain the observed effective temperatures. It is possible that the radio emission is stimulated emission of electrons with energies of 2×10^7 ev in a magnetic field of the order of 1 gauss. The necessary electron flux density is calculated. The possible connection between radio emission and optical radiation in the continuous spectrum and the H and He lines is noted. (auth)

42985 DELAYED EXPLOSION OF A PART OF THE FRIDMAN UNIVERSE, AND QUASARS. Novikov, I. D. Soviet Astron. AJ (English Transl.), 8: 857-63(May-June 1965).

Translated from Astron. Zh., 41: 1075-83(Nov.-Dec. 1964).

A hypothesis interpreting quasistellar radio sources as parts of the Fridman universe delayed in expansion is considered. The matter comprising these delay cores expands beyond its Schwarzschild sphere at different times for different cores. Collision with matter falling in from outside is held responsible for the quasar phenomenon. The exact solution of the gravitational equations describing a cosmological model with delayed cores is derived. The expansion of each core prior to its interaction with the external matter repeats the expansion of the entire Fridman model. The possibility of a situation in which the epoch of expansion of the universe and of the delayed cores is preceded by the epoch of their contraction is also considered. (auth)

42986 HYDROGEN AND ^{4}He FORMATION IN THE PRESTELLAR GAMOW UNIVERSE. Smirnov, Yu. N. Soviet Astron. AJ (English Transl.), 8: 864-7(May-June 1965).

Translated from Astron. Zh., 41: 1084-9(Nov.-Dec. 1964).

The formation of the light elements (hydrogen, deuterium, tritium, ^{3}He, ^{4}He) is traced during the prestellar epoch of the universe, following the theory of Gamow, Alpher, Herman, and Hayashi (initial composition, a "hot" neutron-proton mixture). The theory implies a light-element concentration conflicting sharply with current astrophysical estimates. (auth)

42987 ASYMPTOTIC BEHAVIOR OF THE OPTICAL LUMINOSITY OF A STAR IN GRAVITATIONAL COLLAPSE IN TERMS OF GENERAL RELATIVITY THEORY. Podurets, M. A. Soviet Astron. AJ (English Transl.), 8: 868-73(May-June 1965).

Translated from Astron. Zh., 41: 1090-6(Nov.-Dec. 1964).

The luminosity of a collapsing star having surface light sources is studied. It is shown that the luminosity, as seen by an observer at rest in the Schwarzschild frame of reference, decays exponentially as $t \to \infty$ with a very small characteristic time of the order of the ratio of the gravitational radius of the star to the speed of light in vacuum. (auth)

42988 GEOMAGNETIC DISTURBANCE, PLASMA WIND AND SOLAR ACTIVITY. Sarabhai, V.; Pai, G. L.; Patel, D.; Pathak, P. N. (Physical Research Lab., Ahmedabad, India). 10p. (CONF-641122-1). Gmelin, AED-CONF-64-275-1.

From 2nd Benedum Symposium on Earth Magnetism, Philadelphia.

It is demonstrated by analysing data for 1960, 1961 and 1962 that daily planetary index of geomagnetic disturbance $K_p \geq 25$ occurs about as often with decreases ($\alpha I/\alpha t < 0$) as with increases ($\alpha I/\alpha t > 0$) of daily mean intensity of galactic cosmic rays measured on the earth. The association of these two types of $K_p \geq 25$ epochs and of International Quiet Days with the central meridian passage of long lasting zones of activity in the corona at the solar equator was studied. It is suggested that high K_p is caused by two distinct types of interplanetary conditions, the passage of a corotating shock front or a radially advancing blast wave and the emergency of the earth from a cavity as proposed by Sarabhai considering the consequences of nonuniformity of solar wind velocity. The occurrence of an International Quiet Day is related to c.m.p. of the intermediate point of declining intensity on the trailing edge of a bright coronal zone which should produce a cavity (a region of reduced plasma density and weak magnetic field) where slow plasma does not catch up with fast plasma in front of it. (auth)

Atomic Physics

Refer also to abstract 42696.

42989 (UCRL-12448) FORMATION OF EXCITED HYDROGEN ATOMS FOR NEUTRAL INJECTION. Hiskes, John R. (Lawrence Radiation Lab., Univ. of California, Livermore). June 14, 1965. Contract W-7405-eng-48. 14p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

It is desirable to obtain as large a fraction as possible of the neutral beam in those excited levels which are susceptible ultimately to Lorentz ionization. The population distributions of these excited atoms are discussed as a function of neutralizer parameters. The population distributions which can be achieved by charge exchange in thin targets are discussed. (M.O.W.)

42990 CONTRIBUTION TO THE THEORY OF REFLECTION OF IONS AND ATOMS FROM THE SURFACE OF A SOLID. Parilis, E. S.; Turaev, N. Yu. (Inst. of Physics and Tech., Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 161: 84-7(Mar. 1, 1965). (In Russian).

It is shown that by starting from the screened Coulomb potential and by using a simple model of elastic paired single and multiple collisions it is possible to explain all the principal distinguishing features of the reflection of ions (atoms) from the surface of a solid polycrystalline body. The potential calculated by Firsov with the aid of the Thomas-Fermi model is used to describe the Coulomb repulsion forces. Expressions are obtained for the energy distribution of the ions scattered at a given angle, for the probability of reflection of ion of given energy in a given direction, for the maximum observable ion energy, for the dependence of the ion reflection probability on the angle of incidence, for the angular distribution of the ions, and for the integral reflection coefficient. In the case of single crystals, anisotropy of the angular distributions and a structured nature of the energy distribution is to be expected. At low energies account must be taken of the binding of the atoms in the solid. The region of validity and relative contribution of each of the calculated effects should be investigated separately. (ATD)

42991 PRODUCTION AND DECAY OF NEGATIVE IONS. Smirnov, B. M. (Inst. of Atomic Energy, Moscow). Dokl. Akad. Nauk SSSR, 161: 92-5(Mar. 1, 1965). (In Russian).

A mechanism is described in which negative ions are produced in a low-temperature plasma as a result of charge exchange between an atom with an excited atom. The cross section of such a process is determined by the properties of the quasi-molecules made up of the atoms, and especially by the difference between the terms of the states corresponding to the positive and negative ions on one hand and to two atoms on the other. The cross section for the charge exchange is determined from the splitting of the terms of the two states of the molecules, corresponding to the electron situated near one of the atoms, which are an infinite distance apart. An expression is obtained for the splitting of the terms in terms of the molecular work functions of the corresponding states. The probability of charge exchange of an atom with an excited atom with formation of the negative ion is calculated by the Landau-Zener formula. The conditions under which the results obtained are valid are evaluated. (ATD)

42992 MOMENTUM-TRANSFER THEOREM FOR INELASTIC PROCESSES. Gerjuoy, E. (Univ. of Pittsburgh). J. Math. Phys. (N. Y.), 6: 1396-1402(Sept. 1965).

Recently it was shown that for potential scattering, the well-known optical theorem—relating the total cross section to the imaginary part of the forward scattering amplitude—can be generalized to yield a "momentum-transfer cross section theorem." The previous potential scattering result is generalized further. Specifically, it appears that the momentum-transfer cross-section theorem is valid also for many-particle systems, wherein inelastic processes occur. Although this last assertion probably holds quite generally, a proof is given only for the collisions of electrons with atomic hydrogen. The proof takes into account electron indistinguishability, as well as the possibility that the incident electron ionizes the atom, but assumes the forces are not spin-dependent. (auth)

42993 CONFIGURATION INTERACTION IN THE Gd II SPECTRUM. Smith, G.; Wybourne, B. G. (Argonne National Lab., Ill.). J. Opt. Soc. Am., 55: 1278-83(Oct. 1965).

The observed terms of Gd II can be accounted for by considering the addition of two electrons to just the $^8S_{7/2}$ ground state of the $4f^7$ core. With the use of matrices containing both electrostatic and spin-orbit interactions parameters that yield a good least-squares fit to the experimental levels were derived. The results reveal extensive intermediate coupling within the configurations and strong electrostatic interactions between $4f^7(^8S)5d6s$, $4f^7(^8S)5d^2$, and between $4f^7(^8S)6p6s$, $4f^7(^8S)5d6p$. Tables of observed and calculated energy levels, calculated g_J values, and percentage compositions of eigenstates are presented. The significance of the configuration interaction is discussed, and attention is drawn to an indeterminacy in the over-all phase of the configuration interaction parameters. (auth)

42994 SPECTRUM OF DOUBLY IONIZED LANTHANUM (La III). Sugar, Jack; Kaufman, Victor (National Bureau of Standards, Washington, D. C.). J. Opt. Soc. Am., 55: 1283-5(Oct. 1965).

Forty-five spectral lines of doubly ionized lanthanum in the interval from 700 to 2000 Å are reported. Thirteen previously unreported terms of the ns, np, nd, nf, and ng series are given. Calculations of the limit of three of these series result in a value of 154,672 cm^{-1} for the ionization energy with an estimated uncertainty of ±10 cm^{-1}. (auth)

42995 IONIZATION ENERGIES OF THE SINGLY IONIZED RARE EARTHS. Sugar, Jack; Reader, Joseph (National Bureau of Standards, Washington, D. C.). J. Opt. Soc. Am., 55: 1286-90(Oct. 1965).

Values of the ionization energies of the singly ionized rare earths were obtained by means of a semi-empirical calculation. The uncertainty is estimated to be ±0.08 ev except for Gd II and Lu II where the estimated uncertainty is ±0.4 ev. (auth)

42996 PHOTOELECTRIC CROSS-SECTIONS FOR THE L, M, AND N SHELLS OF URANIUM FOR PHOTONS OF 122 kev. Boyd, H. W.; Brantley, W. H.; Hamilton, J. H. (Vanderbilt Univ., Nashville). Nuovo Cimento (10), 39: 1-9(Sept. 1, 1965).

The internal-external conversion method was used to find the photoelectric cross sections for the L, M, and N shells of uranium for photons of 122 kev. Results obtained are $\tau_L = (360 \pm 40)$ b/atom, $\tau_{L_I}+\tau_{L_{II}}/\tau_{L_{III}} = 3.1 \pm 0.35$, $\tau_L/\tau_M = 4.55 \pm 0.44$, and $\tau_M/\tau_{N+} = 2.5 \pm 0.3$. The τ_L value is higher than that predicted from τ_K when the τ_K/τ_L ratio is assumed to be energy-independent. The $\tau_{L_I}+\tau_{L_{II}}/\tau_{L_{III}}$ and τ_M/τ_{N+} ratios are in agreement with other results. (auth)

42997 ENERGY TRANSFER BETWEEN EXCITED Er^{3+} IONS IN THE ALKALINE EARTH FLUORIDES. Brown, M. R. (Ministry of Aviation, Signals Research and Development Establishment, Christchurch, Hampshire, Eng.); Shand, W. A. Phys. Letters, 18: 95-6(Aug. 15, 1965).

The observation of energy transfer between excited states in Eu^{3+} doped CaF_2, SrF_2, and BaF_2 is reported. The 0.98 μ Eu^{3+} fluorescence was stimulated by two photons in the 1.5 μ region, using a 100-w tungsten iodine source for populating the fluorescence multiplet. The stimulation is interpreted as transitions between energy levels of the $Eu^{3+}-Eu^{3+}$ pairs. (L.B.S.)

42998 INFLUENCE OF SCREENING ON THE ATOMIC PHOTOEFFECT. Matese, J. J.; Johnson, W. R. (Univ. of Notre Dame, Ind.). Phys. Rev., 140: A1-7(Oct. 4, 1965). (COO-427-46).

The atomic photoeffect in a screened Coulomb field is considered. Numerical calculations of the differential and total cross sections for the K and L shells are given. Screening is introduced by including an exponential damping term in the potential. The bound-state wave function and the screening parameter λ are determined by using a variational technique to fit the experimental ionization energy of the shell under consideration. The continuum electron is described by a partial-wave decomposition, and the

interaction with the radiation field is treated in lowest order perturbation theory. A numerical program is developed to obtain the radial part of the continuum wave function. The cross sections are computed numerically and corrections to pure-Coulomb-field results are found to be small for the K shell but significant for the L shell. Results for $\lambda = 0$ are obtained and found to be in good agreement with previous theoretical work. This serves as a check on the accuracy of the numerical computations. A separate calculation using relativistic Hartree wave functions and potentials is carried out for mercury. Comparison of the results of this test calculation with the simplified exponential model indicates that the effects of screening are accounted for reasonably well by the model. (auth)

42999 POSITRON LIFETIME SPECTRA IN MOLECULAR GASES. Osmon, P. E. (Columbia Univ., New York). Phys. Rev., 140: A8-11(Oct. 4, 1965).

Positron lifetime spectra were measured in a wide variety of molecular gases at pressures up to about thirty atmospheres. The spectra were analyzed to yield the free-positron annihilation rate (λ_0^+) and triplet-positronium quenching rate (λ_q) at unit pressure. Attachment of the free positrons occurs in many of the gases. For the others, a strong correlation between λ_0^+ and α, the electric-dipole polarizability at optical frequencies, is found, leading to a general relationship (for both molecular and atomic gases) between these two quantities. This is apparently the first experimental evidence that long-range dipole distortion is the predominant mechanism in low-energy positron scattering. (auth)

43000 THE TRANSITION $1s\sigma_g - 2p\sigma_u$ IN H_2^+ INDUCED BY COLLISION WITH AN ELECTRON, PROTON, OR HYDROGEN ATOM. Peek, James M. (Sandia Lab., Albuquerque, N. Mex.). Phys. Rev., 140: A11-18(Oct. 4, 1965).

The first Born approximation to the transition $1s\sigma_g - 2p\sigma_u$ in H_2^+ is developed. The internal degrees of freedom of the molecular ion are treated explicitly, and in a manner that takes advantage of the dissociative nature of the $2p\sigma_u$ state. The resulting total cross section is found to depend on the initial vibrational state. Numerical results are presented in graphical form for the cases in which this process is caused by collision with an electron, proton, or hydrogen atom. In each case the total cross section is given for all 19 bound vibrational states of the H_2^+ ground state (the $1s\sigma_g$ orbital). In the electron and proton cases the cross section for the lowest ($\nu = 0$) vibrational state is observed to be two orders of magnitude lower than the cross section for the last ($\nu = 18$) bound vibrational state. The dependence on initial vibrational state in the hydrogen-atom case is not as dramatic as in the bare-charge cases, but simultaneous excitation of the hydrogen atom is demonstrated to be an important factor in the shape and magnitude of the cross section. A method of summing simultaneous excitations is presented for the situation in which one particle undergoes a specific transition and the other particle is left in an unspecified state. (auth)

43001 MINIMUM-PRINCIPLE CALCULATION OF THE POSITRON-HYDROGEN s-WAVE PHASE SHIFT. Hahn, Yukap; Spruch, Larry (New York Univ., New York). Phys. Rev., 140: A18-25(Oct. 4, 1965).

The recently developed improved minimum principle for single-channel scattering is applied to a study of the s-wave elastic-scattering phase shift η_0 of positrons by atomic hydrogen. The method requires the exact solution of the static one-body equation and of the corresponding static Green's function, and also the orthogonalization of the trial function to the hydrogenic ground-state wave function. The radial part of the trial function $Q\Psi_t$ is chosen to be of the exponential-polynomial form, with linear and nonlinear variational parameters; to simplify the orthogonalization, $Q\Psi_t$ is expanded in Legendre polynomials whose argument is the cosine of the angle between the coordinate vectors of the electron and the positron. Rigorous lower bounds are obtained on η_0 at various energies. The calculation includes the contributions from hydrogenic states with angular momentum l up to $l = 5$. For each energy, an estimate is made by extrapolation of the true contribution to η_0 from $0 \le l \le 5$, and this estimate is used in turn to estimate the contribution from $l > 5$ to η_0. The rigorous lower bounds obtained and the estimates are compared with previous estimates of η_0. (auth)

43002 IONIZATION OF EXCITED ATOMIC HYDROGEN BY ELECTRON COLLISION. Omidvar, Kazem (Goddard Space Flight Center, Greenbelt, Md.). Phys. Rev., 140: A26-37(Oct. 4, 1965).

A general formula in the Coulomb Born approximation is derived for ionization of the hydrogen atom by electron collision when the atom is in any given initial state. Using this formula, calculations are made for the total ionization cross section and the ionization cross section per unit energy range of the ejected electrons for all substates of the hydrogen atom belonging to the principal quantum numbers $n = 1, 2, 3, 4, 5$. In addition, the ionization cross section of one substate from each of the principal quantum numbers $n = 6, 7, 8, 9, 10$ are calculated. The tabulated results cover the range of energies of interest in plasma calculations. Although the ionization amplitude is given in parabolic coordinates, the ionization cross section for a particular angular momentum of the atom can be obtained by a transformation of the ionization amplitude to spherical coordinates. Comparisons with experiment and other available theories are given. (auth)

43003 EXCITATION BY ELECTRON COLLISION OF EXCITED ATOMIC HYDROGEN. Omidvar, Kazem (Goddard Space Flight Center, Greenbelt, Md.). Phys. Rev., 140: A38-46(Oct. 4, 1965).

The atomic form factor of the hydrogen atom with arbitrary initial and final states is evaluated in closed form using parabolic coordinates. Using this expression the cross section for excitation of the hydrogen atom by electron collision in the Born approximation is evaluated. The total cross sections in the energy range of interest for transitions between the following principal quantum numbers are tabulated: $n = 1$ to $n' = 2, 3, 4, 5, 6, 7, 8, 9, 10$; $n = 2$ to $n' = 3, 4, 5, 6, 7, 8$; $n = 3$ to $n' = 4, 5, 6, 7, 8$; $n = 4$ to $n' = 5, 6$; $n = 5$ to $n' = 6$. In conclusion, a curve for the total of inelastic collisions of electrons with the hydrogen atom in its first five energy levels is constructed. The expression for the atomic form factor may be used in the evaluation of the generalized oscillator strength and in the calculation of the dispersion of x rays in atoms. (auth)

43004 RADIATIVE CASCADE THEORY. Lal, P.; Landsberg, P. T. (University Coll., Cardiff, Wales, U. K.). Phys. Rev., 140: A46-55(Oct. 4, 1965).

A steady-state cascade theory was up for radiative electron transitions. These are assumed to occur between a continuum and various excited states, as well as between any two excited states, of hydrogen-like atoms. The work contains two features which have not previously been fully taken into account: Both spontaneous and induced transition probabilities were included exactly. In addition to the radiative transitions, the reverse transitions due to absorptions of background radiation were also included. The following graphical results are given: The steady-state occupation probabilities of the excited states as a function of excess electron density. A sticking probability P_n (for an electron from a level n to reach the ground state without leaving the atom) as a function of the principal quantum number n. The effect of the cascade on the transition rate into the ground state. The calculation is valid for semiconductors and for the analogous astrophysical problem. Temperature dependences were also studied. The graphs shown bear out quantitatively the expectation that P_n decreases as either the temperature or the principal quantum number increases. (auth)

43005 LOW-ENERGY ELASTIC SCATTERING OF ELECTRONS AND POSITRONS FROM HELIUM ATOMS. Kestner, Neil R.; Jortner, Joshua; Cohen, Morrel H.; Rice, Stuart A. (Univ. of Chicago). Phys. Rev., 140: A56-66 (Oct. 4, 1965).

Calculations are presented of the electron-helium atom

pseudopotential, and from the pseudopotential the cross section for low-energy elastic scattering of electrons from helium atoms. The agreement between experiment and theory is good. In addition, the scattering of low-energy positrons from helium atoms is considered. The case of electron-helium atom scattering is chosen only as an example of the use of the pseudopotential as a natural tool for the study of scattering problems. The numerical calculations demonstrate that the result obtained in this way are of comparable accuracy with the results of more tedious and less instructive approaches. In particular, the use of pseudopotential arguments leads to an easily understood physical description. Moreover, because the pseudopotential approach permits the use of variational procedures, even in the presence of bound (i.e., core) states, the necessary calculations are not difficult to carry through. (auth)

43006 INTERACTION BETWEEN CONFIGURATIONS WITH SEVERAL OPEN SHELLS. Fano, U. (National Bureau of Standards, Washington, D. C.). Phys. Rev., 140: A67-75(Oct. 4, 1965).

Antisymmetrized product wave functions are written for atomic configurations with an arbitrary number of partially or entirely filled shells. Interaction matrix elements between such wave functions are calculated and a numerical evaluation is given for the autoionization of an inner excitation level of neon. A suitable notation keeps the analytical complexities within reasonable bounds. (auth)

43007 EQUILIBRIUM CHARGE-STATE POPULATIONS OF CARBON IONS FROM 2 TO 10 Mev/amu IN H_2, N_2, Ar, AND Ni. Martin, F. W. (Yale Univ., New Haven). Phys. Rev., 140: A75-86(Oct. 4, 1965).

Measurements of the equilibrium fractions of C^{6+}, C^{5+}, and C^{4+} ions as a function of ion energy were made using a gas cell with differentially pumped exit slits and a magnet which spatially separates ions emerging from the slits in different charge states. The separated ion beams are intercepted with different thicknesses of foil and stopped in a junction counter, and charge-state populations are determined from the relative number of counts in each peak of the resulting pulse-height spectrum. Estimated errors are as small as ±0.002 in the population and ±0.05 Mev/amu in the energy. The rms charge of the ions is found to be a function of the material through which they are passing. The rms charge in gaseous N_2 and Ar is higher than in solids of neighboring atomic number at ion energies of 3 Mev/amu, but is the same in these gases and in the solids at 8 Mev/amu. At all energies measured, the charge in H_2 is anomalously high. The increased charge in solids is ascribed to a large electron-loss cross section at low energies, which shortens the time between collisions to the extent that the loss cross section is affected by excitation of the electron of the carbon ion. Estimates based on a crude model indicate that electron capture by the carbon ions takes place predominantly from the K shell of N_2 and the L shell of Ar. The anomalous charge in H_2 is apparently due to the absence of a shell from which capture is highly probable. (auth)

43008 COULOMB SCATTERING OF ELECTRONS IN ALUMINUM WITHOUT ATOMIC EXCITATION. Rester, David H.; Rainwater, Walter J. Jr. (Ling-Temco-Vought, Inc., Dallas). Phys. Rev., 140: A165-8(Oct. 4, 1965).

The differential cross sections for Coulomb scattering of electrons without atomic excitation from thin aluminum targets were measured for incident energies of 0.1, 0.2, 0.5, 0.7, 1.0, 1.25, 1.5, 2.0, 2.5, and 3.0 Mev. The electron spectra were obtained with lithium-ion-drifted silicon detectors at scattering angles from 30 to 150 deg. The experimental cross sections above 0.1 Mev agree within the experimental error with the Mott cross section. (auth)

43009 ON THE DIRECTIONAL DEPENDENCE OF THE SECONDARY ELECTRON EMISSION OF COPPER CRYSTALS IN ION BOMBARDMENT. Zscheile, H. (Technische Universitaet, Dresden, Ger.). Phys. Status Solidi, 11: 159-62(Sept. 1, 1965). (In German).

Measurements are reported of the secondary electron emission from a Cu single crystal, induced by H_1^+ and noble gas ions with energies from 17.5 to 35 kev. The yield depends on the angle of incidence of the ion beam with the target surface and also on the beam orientation with respect to the crystal lattice. The influence of the angle of incidence increases with increase of ion energy and, the influence of the lattice structure increases with ion mass. (auth)

43010 DETERMINATION OF ROTATIONAL RELAXATION TIMES OF HYDROGEN ISOTOPES BY SOUND ABSORPTION MEASUREMENTS AT LOW TEMPERATURES. II. Sluijter, C. G.; Knaap, H. F. P.; Beenakker, J. J. M. (Kamerlingh Onnes Laboratorium, Leiden). Physica, 31: 915-40(June 1965).

Sound absorption measurements in hydrogen isotopes were previously reported. These experimental results are discussed and compared with theoretical investigations, based on calculations of the rotational transitions as published. The connection is pointed out between the cross section, for the rotational transitions, the relaxation time and the experimentally found f/p value of the maximum of the absorption curve. The temperature dependence of the relaxation time is studied. A good agreement is found between theory and experiment for $p-H_2$ and $o-D_2$. A value of the asymmetry parameter of the intermolecular potential is determined from the experimentally found relaxation time for $p-H_2$ and $o-D_2$. The absorption measurements in HD, $n-H_2$ and $n-D_2$ at 77°K are discussed. Suggestions for future measurements are made. (auth)

43011 SPIN-CHANGE CROSS-SECTIONS FOR COLLISIONS BETWEEN ALKALI ATOMS. Dalgarno, A.; Rudge, M. R. H. (Queen's Univ., Belfast). Proc. Roy. Soc. (London), Ser. A, 286: 519-24(Aug. 3, 1965).

A simple procedure is described for the calculation of the interactions between two atoms at intermediate separations and the spin-change cross sections for collisions between pairs of atoms selected from H, Li, Na, K, Rb, and Cs are calculated. Satisfactory agreement with the measured values is obtained. (auth)

43012 STUDY OF FERROMAGNETIC MATERIALS WITH POLARIZED γ-RAYS. Daniel, H. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Z. Physik, 186: 463-7(1965). (In German).

Circularly polarized ^{60}Co gamma-ray quanta were used to measure the polarization-dependent part of the Compton effect on an iron-cobalt alloy. The asymmetry $\delta = (N_+ - N_-)/(N_+ + N_-)$ observed by inversion of the magnetic field direction was investigated as a function of the mean induction $\bar{B}$ between 1 and 23 kΓ. The experimental values of δ do not nearly drop as fast as $\bar{B}$ when going down from saturation to zero. (auth)

43013 AUGER AND COSTER-KRONIG SPECTRA OF THE M-SHELL OF KRYPTON. Mehlhorn, Werner (Universitaet, Muenster, Ger.). Z. Physik, 187: 21-40 (1965). (In German).

The Auger spectra of the M_2, M_3, M_4, M_5 subshells of krypton and the Coster-Kronig spectra of the M_1, M_2, M_3 subshells of krypton were measured with an electrostatic spectrometer. The ionization in the M shells was caused by electron impact. The use of a gaseous target made it possible to measure the Auger lines even at energies as low as 25 ev. The absolute energies and relative intensities of a great number of transitions were determined: 22 of the $M_{4,5}$ spectrum, 14 of the $M_{2,3}$ spectrum, and 2 of the M_1 spectrum. Only in the case of the $M_{2,3}$ spectrum a comparison between the relative intensities, determined experimentally, and those calculated by Rubenstein for Z = 47 was possible. The agreement is only qualitative. Moreover, from the Auger electron energies measured, the following binding energies were calculated: $E(M_1)$ = 292.1 ± 1.0 ev, $E(M_2)$ = 222.1 ± 0.6 ev, $E(M_3)$ = 214.6 ± 0.6 ev, and $E(N_1N_1)$ = 62.81 ± 0.05 ev. (auth)

43014 CHARGE EXCHANGE AND IONIZATION IN PASSAGE OF LIGHT AND HEAVY HYDROGEN IONS

THROUGH LIGHT AND HEAVY HYDROGEN. Hollricher, O. (Universitaet, Geissen, Ger.). Z. Physik, 187: 41-51 (1965). (In German).

Charge exchange and ionization cross sections were measured for the interaction of H^+, H_2^+, D^+ and D_2^+ ions with H_2 and D_2 in the energy range 1.5 to 30 kev. In contrast to earlier measurements showing no isotope effect for a given ion velocity, the results were as follows: The charge exchange cross sections depend on the proportion of the ion mass m_1 and the mass of the target molecule m_2. The cross sections increase with increasing m_2/m_1. As for atomic ions (H^+, D^+), the ionization cross sections could not be distinguished except for the combination $H^+ \rightarrow H_2$. These values are smaller than the others. For molecular ions the cross sections seem to depend only on the mass m_2: $H_2^+ \rightarrow H_2$ coincides with $D_2^+ \rightarrow H_2$ and $H_2^+ \rightarrow D_2$ coincides with $D_2^+ \rightarrow D_2$. The latter values are higher than the first ones. The results are discussed by means of a collision model. A possible reason for the isotope effects is given. (auth)

43015 UP TO DATE GAS ELECTRONOGRAPHY. THE THEORY OF ATOMIC SCATTERING OF ELECTRONS. Spiridonov, V. P.; Rambidi, N. G.; Alekseev, N. V. (Moscow State Univ.; Inst. of Elementary Organic Compounds, Academy of Sciences, USSR). Zh. Strukt. Khim., 6: 481-504(May-June 1965). (In Russian).

A review is given of the quantum mechanical theory of fast electron scattering by free atoms. The problem of atomic scattering was analyzed in the approximation of central power fields. Effects of various factors on atomic amplitudes of scattered electrons were studied in various approximations. The theory of inelastic fast electron scattering in the Born approximation is discussed. (tr-auth)

43016 IONIZATION CROSS SECTIONS FOR ELECTRON IMPACT IN THE ENERGY RANGE OF 0.1 TO 20 kev. Schram, B. L.; Boerboom, A. J. H.; de Heer, F. J.; van der Wiel, M. J.; Kistemaker, J. (FOM-Laboratorium voor Massascheiding, Amsterdam). 5p. (CONF-650519-4). Gmelin, AED-CONF-65-120-19.

From 13th Annual Conference of American Society of Testing Materials, St. Louis.

Measurements were made of the total ionization cross sections for noble and diatomic gases at 0.1 to 20 kev, and for hydrocarbons from 0.6 to 12 kev, and also of the partial ionization cross sections for noble gases from 0.5 to 15 kev, in order to test the Bethe-Born approximation and to obtain information about M_1^2 which is a factor related to the oscillator strength. (L.B.S.)

Cosmic Radiation

See also Elementary Particles and Radiations. Nuclear Properties and Reactions.

43017 (AD-601274) MEASUREMENT OF FLUORESCENT X-RADIATION FROM THE MOON AND FOR THE DETECTION OF OTHER X-RAY SOURCES IN THE NIGHT SKY. Giacconi, Riccardo; Gursky, Herbert; Paolini, Frank (American Science and Engineering, Inc., Cambridge, Mass.). Aug. 20, 1963. Contract AF19(604)-8026. 86p. (ASE-426). CFSTI $8.10 cy, $0.75 mn.

A research program was conducted to investigate the fluorescent x radiation from the lunar surface and other possible sources of x rays in the night sky. A detailed description of a rocket experiment comprising large area Geiger counters is presented. The results of two rocket flights carrying the experimental equipment are shown. One of these rocket flights, occurring in June 1962, resulted in the discovery of an intense source of x rays, not of solar or terrestrial origin, in the direction of the constellation Scorpius. Also present is a considerable background of soft radiation, which apparently is also x radiation of non-solar or terrestrial origin. These sources have important astrophysical significance, but their origin is not yet clear. In view of the background of soft radiation encountered in the flight, it was not possible to make a meaningful estimate of the x-ray flux originating from the Moon. Several experiments are described in which it should be possible to measure the lunar flux in the presence of this newly discovered background of x rays. (auth)

43018 (AD-609216) THE INTERACTION BETWEEN THE SOLAR WIND AND THE EARTH'S MAGNETIC FIELD. Final Report. Frankenthal, S.; Carpenter, J. W.; Olbert, S.; Penhune, J. P.; Siscoe, G.; Treve, Y. M. (American Science and Engineering, Inc., Cambridge, Mass.). Apr. 1964. Contract AF19(628)-270. 214p. (AFCRL-64-433; ASE-509). CFSTI $6.00 cy, $1.25 mn.

The interaction between the solar wind and the earth's magnetic field is studied, taking into account: the presence of an interplanetary magnetic field within the solar wind; and the possibility that the solar wind may be penetrated by field lines emanating from the earth. A qualitative discussion is given of the field and flow patterns that may develop under the stated conditions. Two methods are studied for the treatment of the MHD equations which govern the interaction, namely expansion in spatial coordinates, and parametric expansions. The first method, which is suitable for local studies of the flow, is applied to the region in the immediate vicinity of the stagnation line behind the bow shock. The results of this treatment are embodied in a local field-flow pattern, which reveals several features that can be attributed directly to the presence of an interplanetary field within the solar wind, weak as those fields may be. (auth)

43019 (NASA-TN-D-2798, pp 163-8) SOLAR X-RAY BURSTS IN THE 20 TO 100 kev RANGE OBSERVED BY OSO-I. Frost, Kenneth J. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center).

During March, April, and May, 1962, instrumentation aboard OSO-I observed five solar-flare-associated high-energy x-ray bursts. The instrumentation which observed these bursts was designed to monitor the solar x-ray flux in the 20 to 100 kev energy range. The beginning and the end of each event was observed. All events were accompanied by radio bursts of impulsive character in the microwave range. Plots of flux density versus wavelength for the associated microwave outbursts yield curves similar to the curves associated with previously observed x-ray bursts. Sudden ionospheric disturbances also accompany each high-energy x-ray burst. Consideration of the radio data, the short duration of the x-ray bursts, and the energy of the bursts lead to the conclusion that a process is observed that is located in the chromosphere and is non-thermal in character. (auth)

43020 STUDIES OF THE X RADIATION OF THE SUN WITH THE AID OF EARTH SATELLITES AND GEOPHYSICAL ROCKETS. Mandelstam, S. L. Naturw. Rundschau, 18: 24-5(Jan. 1965). (In German).

It is relatively difficult to detect solar radiation of less than 3000 Å because it is completely absorbed by the earth's atmosphere, and therefore can not be detected at the earth's surface. Measurements made by means of rockets and earth satellites show that the amount of radiation with wavelengths less than 3000 Å constitutes only ~1.5% of the solar energy emitted, while the fraction of radiation with wavelengths shorter than 100 Å is 10^5 times as small. However, these short waves have special significance because they affect the physical state of the upper atmosphere. Solar x radiations of less than 20 Å have been studied with photon counters. Since the orbits of the satellites used lie partially within the Van Allen belt, the detectors were shielded. The intensity of x radiation increases sharply above 90 km during the vertical rise of the satellites. The intensities seem to vary with solar activity, and may range from 2 to 7×10^{-4} erg/cm^2 sec. During solar eruptions, the wavelengths seem to be shifted into the 0.1- to 1-Å range. Measurements made by rockets indicate that there are four relatively stable regions of irradiation activity in the spec-

tral range of 170 to 400 Å. Two components of x radiation are measurable. One is continuous and is associated with a quiet sun, but the second is superimposed on this as a result of solar disturbance. There is a correlation between the intensity of the x radiation and the radiation in the wavelength range of 10 cm. The thermal movement of electrons is the basic cause of the x radiation emitted from the quiet sun. Probably the most important energy sources for the coronal radiation in the spectral range of 1 to 100 Å are free transitions. Intensities calculated on this basis agree with measured radiation intensities by an uncertainty factor of 2 or 3. (BBB)

43021 COSMIC RADIATION IN ASTROPHYSICAL RESEARCH. Meyer, P. Naturw. Rundschau, 18: 26(Jan. 1965). (In German).

The origin of cosmic radiation is discussed, together with the effects of the interaction of cosmic radiation with interstellar magnetic fields and particles. Findings are summarized which indicate that explosions of supernovae are the main source of cosmic radiation. (D.C.W.)

43022 PRIMARY COSMIC-RAY ALPHA-PARTICLES. IV. ENERGY SPECTRUM AT 41 deg N GEOMAGNETIC LATITUDE. Guss, D. E. (Washington Univ., St. Louis). Nuovo Cimento (10), 39: 27-42(Sept. 1, 1965).

From the analysis of an emulsion stack exposed to primary cosmic radiation over Texas on February 8, 1959, the α-particle integral energy spectrum was found to be well represented by a simple power law of the total energy $N(W) = CW^{-\gamma}$ in the kinetic energy range (2.5 to 7.5) Bev/nucleon. The value of the exponent was found to be $\gamma = 1.56 \pm 0.18$, which is not appreciably different from a value $\gamma \simeq 1.65$ found at solar minimum in the kinetic energy range (1.8 to 3) Bev/nucleon. A slightly smaller exponent at solar maximum is consistent with a solar modulating mechanism which preferentially removes low-energy particles from the primary cosmic-ray spectrum. These emulsions were exposed at a time near solar maximum, and the result is not consistent with a value $\gamma = 1.0$ in this energy range at solar maximum, as suggested previously. By using glass-backed plates and a low-temperature isothermal processing technique, the emulsion noise was reduced to a level where measurements could be extended to α-particle kinetic energies of 7.5 Bev/nucleon. Agreement of the point on the integral spectrum at a kinetic energy of 7 Bev/nucleon with flux values found at Guam during a period of similar cosmic-ray intensity shows that there is no significant noise contribution in these emulsions which varies with cell size in the same way as the Coulomb scattering signal. (auth)

43023 COSMIC-RAY AZIMUTHAL ASYMMETRY MEASUREMENTS AT MAWSON, ANTARCTICA. Cooke, D. J. (Dept. of External Affairs, Melbourne). Nuovo Cimento (10), 39: 43-9(Sept. 1, 1965).

Observations in eight directions of the hard-component azimuthal intensity distribution at Mawson show that the observed azimuthal asymmetries are markedly different from those theoretically predicted. In particular, where a north-south asymmetry of the order of 0.7% is expected, a zero value is observed. (auth)

43024 DETECTION OF MUONS PRODUCED BY COSMIC RAY NEUTRINOS DEEP UNDERGROUND. Achar, C. V. (Tata Inst. of Fundamental Research, Colaba, India); Menon, M. G. K.; Narasimham, V. S. (and others). Phys. Letters, 18: 196-9(Aug. 15, 1965).

An experiment was designed for the detection of muons produced in the interactions of cosmic ray neutrinos, and operated in the Kolar Gold Mines at a depth of 7600 ft. A description is given of the detection equipment, arrangement and procedure. The observed number of events in 100 telescope-days are tabulated for three classes along with the expected number of muons from neutrino interactions and of atmospheric muons. The results are also discussed. (L.B.S.)

43025 NUCLEAR INTERACTION OF VERY HIGH ENERGY MUONS AT LARGE MOMENTUM TRANSFER. Fujimura, Kimio (Waseda Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 34: 1-19(1965).

A new model is presented for the theoretical approach to the nuclear interaction of very high energy muons with large energy transfers of a few hundreds Bev. The model is based on the assumption that the virtual photon with large virtuality, which accompanied by the muon, dissociates into a pair of heavy particles and one of the particles interacts with the target nucleon. In contrast with the Weizsäcker and Williams theory, the model is considered to be applicable to events with large energy transfer. Nevertheless, it is shown that the present theory is not consistent with the observed abnormally large cross section group. This might mean that the abnormal event would conflict with such a fundamental thing of the present-day physics as the validity of the perturbation theory for electromagnetic interaction or of the constancy of the γN total cross section at the high energy limit. (auth)

43026 PRODUCTION OF SOLAR ENERGETIC PROTON EVENTS BY HYDROMAGNETIC SHOCKS. Weddell, J. B. (North American Aviation, Inc., Downey, Calif.). 17p. (CONF-641218-1). Gmelin, AED-CONF-64-271-11).

From American Geophysical Union, 4th Western Regional Meeting, Seattle.

The results are presented of an analysis of the acceleration of solar wind protons by a coronal hydromagnetic shock wave of the form considered by Parker, the scattering of the accelerated protons out of the shock, and the transport of the scattered protons through the interplanetary medium. (L.B.S.)

43027 NEUTRON MULTIPLICITY MONITOR RESPONSE TO COSMIC RADIATION AT SOLAR MINIMUM. Nobles, R. A.; Newkirk, L. L.; Walt, M.; Reynolds, G. T. 13p. (CONF-650422-6). Gmelin, AED-CONF-65-118-22.

From American Geophysical Union, Program for Section of Seismology Annual Meeting, Washington, D. C.

A description is given of a neutron multiplicity monitor which is used to observe the intensity and energy spectrum of the nucleonic component of the secondary cosmic radiation. The monitor is designed to produce and detect the maximum number of neutrons from each incident nucleon and to determine the multiplicity with which they are produced, using a Bi target for neutron production, a graphite moderator, and 26 BF_3 counters for their detection. The response of the monitor for a typical four weeks interval, and also during a flare or Forbush decrease, is illustrated and discussed. (L.B.S.)

Direct Energy Conversion

43028 (AD-609966) THE DEVELOPMENT OF A LOW-TEMPERATURE CYLINDRICAL THERMIONIC GENERATOR. Third Quarterly Technical Report. (Radio Corp. of America, Lancaster, Pa. Direct Energy Conversion Dept.), Dec. 1964. Contract AF33(615)-1547. 50p. CFSTI $2.00 cy, $0.50 mn.

The evaluation and analysis of Type A-1198B insulated converters provided additional evidence that the A-1198B is a reliable, long-life design, and that the cast alumina layer is an effective insulator. Four improved Type A-1274A Modules, Serial Numbers 2 through 5, were fabricated. The improved reliability of the module was demonstrated in calibration tests of Module Serial No. 4, when more than 240 hours of operating time was accumulated over a wide range of operating conditions. Tests showed that although the A-1274A is capable of full design performance, additional collector cooling is required. Consequently, the radiation heat rejection system for Module Serial No. 5 was redesigned. Tests with the gas dosing injection system indicated the need for more accurate gas injection, and the system was subsequently modified. Collectors of cesium fluoride, cesium sulfate, tungsten trioxide, iridium matrix, and palladium matrix were tested in Type A-1194E converters in the low-work function collector investigation. Results were unsatisfactory. Data were

compiled and analyzed on both molybdenum and niobium high-temperature collectors. The results showed that collectors can be operated as high as 700°C (with an emitter temperature of 1350°C) without inordinate loss of power. (auth)

43029 (NASA-TN-D-2973) ANALYSIS OF A RADIAL-FLOW HALL CURRENT MAGNETOHYDRODYNAMIC GENERATOR. Nichols, Lester D. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Aug. 1965. 16p. CFSTI $1.00 cy, $0.50 mn.

A magnetohydrodynamic generator of two-disk geometry operating in the Hall mode is considered. The generator working fluid flows radially between the two disks and a constant magnetic field is applied parallel to the axis of the disks. The conditions where the Mach number is small compared to one and where viscous effects can be neglected are analyzed. The power output, power-output density, and efficiency of this generator are determined and compared to the linear Hall generator. The calculations indicate that the linear generator has higher efficiency and power output for a given working fluid and entrance velocity. (auth)

43030 (PIC-SOL-209/5.1(Vol.II)) THIN FILM SOLAR CELLS AND SOLAR CELL TESTING. VOLUME II. Proceedings of the Fourth Photovoltaic Specialists Conference Held at the NASA-Lewis Research Center, Cleveland, Ohio, June 3, 1964. (Power Information Center, Univ. of Pennsylvania, Philadelphia). Aug. 1964. Contract NASr-191. 295p. (CONF-657; NASA-CR-69014; N64-32726). CFSTI $6.00 cy, $1.50 mn.

Papers are presented on the topics of preparation, fabrication, radiation damage, testing, and performance of photovoltaic cells and solar cells. The materials considered include GaAs, CdTe, CdS, and Si. Panel discussions are also included. None of the papers have been abstracted separately. (T.F.H.)

43031 THE DIMENSIONING OF MHD GENERATOR DUCTS. Burhorn, Fritz; Gruenwald, Erich. Siemens-Z., 39: 467-73(May 1965). (In German).

Several questions of importance in connection with the dimensioning of MHD generators are discussed. These include the chemical composition, the enthalpy, and the conductivity of the plasma taking into account the seeding; the power density; and the influence of the Hall effect. The system of basic hydromagnetic equations is also discussed. As numerical examples, descriptions are given of the performance of several channel sizes. (auth)

43032 HIGH-TEMPERATURE THERMOELECTRIC SYSTEMS FOR SPACE POWER AT MULTI-KW(e) LEVELS. Hedley, W. H.; Strop, H. R. (Monsanto Research Corp., Dayton, Ohio). 29p. (CONF-650602-57). Gmelin, AED-CONF-65-125-71.

From American Nuclear Society, 11th Annual Meeting, Gatlinburg, Tenn.

A preliminary study was made of the specific power and other performance parameters of high-temperature thermoelectric space power systems with fast reactor heat sources, operating at multi-Kw(e) output levels. Brief descriptions are given of three concepts of fast-reactor-heated systems, the analytical approach used to investigate such systems, and calculated system performances. Specific power ratings from more than 300 lbs/Kw(e) down to 15 lbs/Kw(e) were calculated, the results being strongly dependent upon the specific conceptual design, the hot- and cold-junction temperatures of thermoelectric legs, and the power level. These ratings are quite attractive when compared with SNAP systems presently under development. (auth)

43033 IMPROVEMENTS IN OR RELATING TO ELECTRODE STRUCTURES FOR MAGNETOHYDRODYNAMIC GENERATORS. (to Westinghouse Electric Corp.). British Patent 997,143. July 7, 1965. Priority date July 13, 1962, United States.

An electrode structure for disposal along the duct of a MHD thermal to electrical conversion apparatus comprises a base member having a surface disposed adjacent to the flow of ionized working fluid and protective gas inlet means operative to supply an electrically conductive protective gas to the base member. The base member has passages to allow the protective gas to pass through and to provide an electrically conductive layer of protective gas between the surface and the flow of working fluid. (B.L.M.)

43034 IMPROVEMENTS IN OR RELATING TO ELECTRODE PROTECTION FOR MAGNETOHYDRODYNAMIC GENERATORS. (to Westinghouse Electric Corp.). British Patent 997,144. July 7, 1965. Priority date July 13, 1962, United States.

A MHD energy conversion apparatus is provided in which means are incorporated to protect the electrodes from oxidation. To prevent the gradual deterioration of the electrodes, members that may be comprised of graphite are disposed along the generator duct between the mixing chamber and the generator chamber. As combustion products of the hot working fluid pass over the members, substantial amounts of C are introduced into the flow of gas. Thus CO is produced that flows along the inner wall of the duct to provide a protective layer over through the orifices and into the duct. Instead of the carbon members, carbon producing liquids, such as benzene or propane, can be used, which when introduced into the hot flow of working fluid ignite and through decomposition and partial combustion produce soot. The particles of free C in the soot combine with O_2, CO_2, and H_2O to form CO serves as a protective layer for the electrodes downstream. (B.L.M.)

Elementary Particles and Radiations

Refer also to abstracts 43197 and 43273.

43035 (AD-448108) BACKWARD ANOMALY IN π MESON PHOTOPRODUCTION. Hearn, A. C. (Stanford Univ., Calif. Inst. of Theoretical Physics); Schaerf, C. (Stanford Univ., Calif. High-Energy Physics Lab.). Sept. 1964. Contracts Nonr22567 and AF49(638)-1389. 11p. (ITP-133).

The differential cross sections for photoproduction of π^0 mesons on hydrogen at 660 to 780 Mev are measured. These cross sections reveal an anomalous angular distribution in the region of high momentum transfer (backward region). It is shown that the observed enhancement may be interpreted as being due to the effect of crossed-nucleon and crossed-pion-nucleon isobar exchanges that contribute to the process. A polynomial fitting technique is used, assuming up to five poles in the backward region. (T.F.H.)

43036 (AED-C-23-04) HIGH ENERGY PHYSICS. Series C: Bibliographies. Section 23, No. 4. Mellentin, K.; Vierk, I. (comps.) (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Oct. 1964. 185p. Dep. mn.

A bibliography of literature on high energy physics is presented. The bibliography is for literature received at DESY after 1962. (M.O.W.)

43037 (BNL-9364) ISOTOPIC SPIN (SU_2) AND THE EIGHT-FOLD WAY (SU_3) FROM AN ELEMENTARY VIEWPOINT. Internal Report. Adair, Robert K. (Yale Univ., New Haven, Conn. and Brookhaven National Lab., Upton, N. Y.). July 1965. Contract AT(30-2)-Gen-16. 38p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Separate sections on symmetry are discussed from an elementary viewpoint. The discussion concerns: the neutron-proton symmetry, SU_2 and the elementary particles, the eight-fold way, SU_3, and the consequences of SU_3. (M.O.W.)

43038 (CERN-65-27) SEPARATEUR DE PARTICULES BASE SUR L'IDENTIFICATION PAR UN DISC. (Particle Separator Based on the Identification by a Disk). Meunier, R.; Spighel, M.; Stroot, J. P.; Duteil, P. (European Organization for Nuclear Research, Geneva (Switzerland)). July 1965. 14p. Dep. mn.

A method is proposed for separating particles at high energies. The method uses the identification of the particles by a gaseous disk Cherenkov counter and separation by pulsed electric deflection. A possible schematic representation is given. The magnetic delay channel, the acceptance of a disk separator, the characteristics of the electric deflection, and characteristics of the disk are discussed. The delays in the identification are considered. The advantages of this system for the separation of particles are described. It is concluded that the development of such a particle separator is feasible at present. (J.S.R.)

43039 (COO-1195-34) PHOTOPRODUCTION OF CHARGED PIONS FROM DEUTERIUM NEAR THRESHOLD (thesis). Yoon, Taek-Soon (Illinois Univ., Urbana. Dept. of Physics). May 1964. Contract AT(11-1)-1193. 83p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

A hardened x ray beam was passed through a 14 inch liquid deuterium bubble chamber. About 5400 π^--photoproduction events and about 2700 π^+-photoproduction events were found. The π^- to π^+ ratio was determined for seven pion laboratory energy and angle bins, using the π^+ events observed. Coulomb corrections were applied to these results. A Chew-Low unstable target extrapolation procedure was used to obtain the cross section for the π^--photoproduction process from a free neutron. A correction factor was calculated to eliminate the effects of Coulomb interaction and specific nuclear force interaction of the recoiling protons in the final state. (M.O.W.)

43040 (CU-1932-244) ANNIHILATION OF ANTIPROTONS IN HYDROGEN AT REST. II. ANALYSIS OF THE ANNIHILATION INTO THREE PIONS. Baltay, C.; Franzini, P.; Gelfand, N.; Luetjens, G.; Severiens, J. C.; Steinberger, J.; Tycko, D.; Zanello, D. (Nevis Labs., Columbia Univ., Irvington-on-Hudson, N. Y.). July 1965. Contract AT(30-1)-1932. 16p. (NEVIS-138; R-510). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Analysis of 823 events attributed to the reaction $\bar{p} + p$ (at rest) $\rightarrow \pi^+ + \pi^- + \pi^0$ yields the results: that the channel accounts for 7.8% of the annihilations; that 0.55 ± 0.05 of the channel proceeds via ρ production, and the capture to $\rho\pi$ is from the $^3S_1$ state; and that 0.45 ± 0.05 of the channel is nonresonant and this nonresonant production is from the $^1S_0$ state. (auth)

43041 (IC/65/64) SU_9 SYMMETRY AND NON-LEPTONIC DECAYS. Cocho, G. (International Centre for Theoretical Physics, Trieste (Italy)). June 1965. 7p. Dep. mn.

A study of nonleptonic decays of hyperons is made on the assumption that the weak interaction hamiltonian transforms as the regular representation of SU_9 (or $\tilde{U}_{27}$). In particular, the assumption that the weak hamiltonian belongs to the central component of the $SU_3(\vec{S},B)$ octet in $SU_9 \supset SU_3(\vec{S},B) \otimes SU_3(\vec{T},Y)$ is made. Some numerical values for the observed decays of hyperons (Λ), (Σ^-), (Σ^+), (Σ^0), and (Ξ^-) are given. (M.O.W.)

43042 (IC/65/70) THEORY OF GROUPS AND THE SYMMETRY PHYSICIST. Salam, Abdus (International Centre for Theoretical Physics, Trieste (Italy)). July 1965. 20p. Dep. mn.

Recent successes of the group theory method in classification schemes for elementary particles are pointed out. Particular problems in the representation theory of noncompact groups are discussed. The overall picture of group theory for symmetry physics is discussed. (M.O.W.)

43043 (JINR-P-2202) ZAVISIMOST NAKLONA DIFRAKTSIONNYKH KRIVYKH pp, $\bar{p}p$, K^+p, K^-p, π^+p, I π^-p RASSEYANIYA OT ENERGII. (Energy Dependence of the Slope of the Diffraction Curves for pp, $\bar{p}p$, K^+p, K^-p, π^+p, and π^-p-Scattering). Lyubimov, A. L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1965. 6p. Dep. mn.

It is shown that the energy dependence of the slope of the diffraction curves for elastic pp, $\bar{p}p$, π^+-p, and K^+-p-scattering can be described in a unique manner. This dependence demonstrates a shrinkage of the diffraction pattern with energy for all the mentioned scattering processes. It shows also that the total interaction cross sections affect the slope of the diffraction curve. (auth)

43044 (JINR-P-2255) ISSLEDOVANIE REAKTSII $\pi^- + p \rightarrow \pi^- + \gamma + p$ PRI ENERGII 338 Mev. (An Investigation of the Reaction $\pi^- + p \rightarrow \pi^- + \gamma + p$ at 338 Mev). Blokhintseva, T. D.; Grebinnik, V. G.; Libman, G.; Zhukov, V. A.; Nemenov, L. L.; Selivanov, G. I.; Yuang Rung-Fang (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1965. 21p. Dep. mn.

From the analysis of the reaction $\pi^- + p \rightarrow \pi^- + \gamma + p$ the constant of the process $\gamma + \pi \rightarrow \pi + \pi$ was determined. (auth)

43045 (JINR-P-2258) METOD OPREDELENIYA CHETNOSTI Ω^--GIPERONA. (A Method of Determination of the Ω^--Hyperon Parity). Bilen'kii, S. M.; Ryndin, R. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 6p. Dep. mn.

A method of determining the Ω^- hyperon parity is suggested. It is based on invariance under reflections in the reaction plane and requires a study of the reaction $K^- + p \rightarrow \Omega^- + (K^+ K_0)_{1280}$ on a polarized proton target. (auth)

43046 (NIRL/R/98) NEUTRON-PROTON SCATTERING EXPERIMENTS NEAR 50 Mev. Batty, C. J. (National Inst. for Research in Nuclear Science, Chilton (England). Rutherford High Energy Lab.). Mar. 1965. 26p. Dep. mn; BIS $0.80; HMSO 4s.

The neutron-proton scattering experiments required to improve the accuracy of the T = 0 phase shifts at energies near 50 Mev are considered. (auth)

43047 (NP-15286) THE APPLICATION OF UNITARY GROUPS IN PARTICLE PHYSICS WITH PARTICULAR EMPHASIS ON SU_6. Lectures given at Universitetets Institut for Teoretisk Fysik and NORDITA, Copenhagen. Brene, N.; Hellesen, B. (Nordisk Institut for Teoretisk Atomfysik, Copenhagen (Denmark)). Mar. 1965. 46p. Dep. mn.

The foundations of the application of SU(6) group theory to elementary particles are outlined. (T.F.H.)

43048 (NP-15377) OBNARUZHENIE REZONANSA V SISTEME $K^0\bar{K}^0$ PRI 1280 Mev. (Evidence for $K^0\bar{K}^0$ Resonance at 1280 Mev). Report No. 284. Barmin, V. V.; Dolgolenko, A. G.; Yerofeev, I. A.; Krestnikov, Yu. S.; Meshkovskii, A. G.; Tikhomirov, G. D.; Trebukhovskii, Yu. V.; Shebanov, V. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1964. 17p. Dep. mn.

Stereo-photographs of 159 pairs of $K^0\bar{K}^0$ were obtained by exposing a 17-liter propane-xenon bubble chamber to a 2.8 Bev/c meson (π^-) beam of the ITEP proton synchrotron. The mesons (K^0) were registered with $K_1^0 \rightarrow \pi^+ + \pi^-$ decay. The distribution of the effective mass $K^0\bar{K}^0$ pairs shows the bump at 1280 Mev with the width ~80 Mev. This result coincides with the data of a paper by Barmin et al. United distribution contains 194 pairs of $K^0\bar{K}^0$. The number of events in the peak is about 35. This peak cannot be explained by the reaction $\pi^- + N \rightarrow \pi^- + N + K^0 + \bar{K}^0 + m\pi$ (m = 0, 1, 2, 3 ...) or known resonances in the KN and Kπ systems. The hypothesis is discussed that the peak may be explained by f- and A_2^0-mesons productions with following decays $f \rightarrow K_1^0 + K_1^0$ and $A_2^0 \rightarrow K_1^0 + K_1^0$. The high limit was obtained for the ratio $w(f \rightarrow K_1^0 + K_1^0)/w(f \rightarrow \pi^+ + \pi^-) \leq 2.3 \pm 1.0\%$. (auth)

43049 (NP-15392) UNITARNOE I SPINOVOE SODERZHANIE SUPERMUL'TIPLETOV SU(6). (Unitary and Spin Content of SU(6)). Report No. 337. Derelomov, A. M.; Malkin, I. A. (Gosudarstvennyi i Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1965. 41p. Dep. mn.

A method is developed which allows one to find a number of unitary multiplets with given spin in supermultiplets of the SU(6) group. The table of expansions of all the SU(6) representations given by the Young tableaux with the total number of boxes f = 3,6, and 9 is presented. The expansion

of the SU(6) supermultiplet in the Wigner supermultiplets with the fixed value of hypercharge and spin of Λ-quarks: SU(6) ⊃ SU(4) ⊗ SU(2) ⊗ U(1) was obtained. The table of expansion of the Kronecker product of the SU(6) simplest representations is also given. (auth)

43050 (NP-15395) VYROZHDENNAYA SU_4-SIMMETRIYA SIL'NYKH VZAIMODEISTVII. (Degenerated SU_4-Symmetry of Strong Interactions). Report No. 353. Vladimirskii, V. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1965. 18p. Dep. mn.

The assumption on the degeneration of strong interaction relative to the one of quantum numbers of the SU_4 group results in essential reduction of the number of states with different masses. Degenerated supermultiplets SU_4 are like the SU_3 supermultiplets: in the regular 15-dimension representation there is only one excess mass as compared with the octet, in the 20-dimension representation, analogous to baryonic octet – there are two (Ξ_{1395}, Ω_{1560}), in the 20-dimension representation, analogous to the decuplet there are no excess masses. The doubling of the number of K-meson states makes possible to get phenomenological description of CP-parity violation in $K_2^0 \to 2\pi$ decay. (auth)

43051 (UCRL-16089) A MEASUREMENT OF THE POLARIZATION OF Σ^0 HYPERONS PRODUCED BY π^- MESONS ON HYDROGEN NEAR 1.3 Bev/c (thesis). Crolius, Richard L. (Lawrence Radiation Lab., Univ. of California, Berkeley). May 26, 1965. Contract W-7405-eng-48. 55p. Dep. mn; CFSTI $3.00 cy, $0.50 mn.

Spark chambers were used to detect $\Sigma^0 + K^0$ production by π^- mesons on hydrogen in the π^- momentum range 1200 to 1400 Mev/c. Differential cross-section measurements are presented. The differential cross sections remain unchanged, within the limits of statistics, from 1200 to 1400 Mev/c. A measurement of the Σ^0 polarization indicates that the polarization may be changing rapidly with beam momentum, but poor statistics prevent establishing this conclusively. (auth)

43052 (AD-426473) HIGH ENERGY PHYSICS IN THE USSR. Veksler, V. I. Translation of speech made at the National Science Foundation, Washington, D. C., October 25, 1963. 15p. (AID-T-63-124). CFSTI.

A discussion of the development and present state of high-energy physics research in the USSR is presented. Modern concepts of elementary-particle physics, theoretical research, the High-Energy Laboratory, Laboratory of Nuclear Problems, Physics Institute of the Academy of Sciences, and research on new accelerators are discussed. (M.O.W.)

43053 ON A RELATIVISTIC SINGLE-POINT MODEL OF ELEMENTARY PARTICLE. Borelowski, Z. (Jagellonian Univ., Krakow). Acta Phys. Polon., 27: 821-9 (June 1965).

A free point singularity in Minkowski space is considered whose motion is determined by the variational principle. The Lagrangian is chosen so that its four-momentum vector shall be non-parallel with regard to its four-velocity vector. A relation is derived from the equations of motion of the singularity in the special reference system Σ_0 between the spin, rest mass and diffluence of the particle, which is interpretable, e.g., as the relation between mass and spin resulting in the case of baryon resonance. (L.B.S.)

43054 SOME ASPECTS OF THE MULTIPLE PRODUCTION OF PIONS BY 16 Gev/c π^- ON PROTONS. Bartke, J. (Inst. of Nuclear Research, Krakow); Piotrowska, H.; DeMarco, A. Trąbucco. Acta Phys. Polon., 27: 869-79 (June 1965).

170 inelastic interactions of 16 Bev/c negative pions in hydrogen with four and more charged secondaries were studied. Angular and momentum distributions of secondary particles in the c.m.s. are given and certain momentum-emission angle correlations shown. A peripheral character of interactions is evident for four-prong events and less apparent for higher multiplicities. An evidence was obtained that the ratio of neutral-to-charged pions decreases with increasing multiplicity of charged prongs. (auth)

43055 ISOSPIN CROSSING MATRICES FOR PHOTOPRODUCTION OF MANY PARTICLES. Kotanski, Andrzej (Jagellonian Univ., Krakow). Acta Phys. Polon., 27: 937-45(June 1965).

General rules of constructing invariant amplitudes are proposed, even when the symmetry is broken in some way. The crossing matrix is always square and quasi-diagonal – the scalar, vector, and other parts of the amplitude do not mix in crossing. As the application of the formalism the invariant isospin amplitudes for the photoproduction process are chosen and crossing matrices evaluated. (auth)

43056 A UNIFIED DESCRIPTION OF SPACE-TIME AND ISOSPACE. [PART] I. Rayski, Jerzy (Jagellonian Univ., Krakow). Acta Phys. Polon., 27: 947-53(June 1965).

The assumption of an N-dimensional manifold with four open dimensions forming the ordinary space-time and N – 4 closed dimensions forming an isospace is investigated. In the case N = 7 the properties of the nucleonic iso-doublet and the mesons pi and omega find a very natural explanation. The circumference of the closed dimensions seems to be related to the weak coupling constant. (auth)

43057 A UNIFIED DESCRIPTION OF SPACE-TIME AND ISOSPACE. [PART] II. Rayski, Jerzy (Jagellonian Univ., Krakow). Acta Phys. Polon., 28: 87-93(July 1965).

The assumption of an N-dimensional space-time with redundant dimensions closed on a microscopical scale yields a geometrical interpretation of the intrinsic properties of baryons and mesons. The existence of the baryonic octet and the mesons pi, K, omega, eta, ro, and K* with their characteristic properties like spin, parity, isospin, hypercharge, G-parity and C-parity find a natural explanation. (auth)

43058 HIGH-ENERGY BEHAVIOUR OF THE REAL PART OF A CHARGE-EXCHANGE AMPLITUDE. Wit, R. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Polon., 27: 989-91(June 1965).

The high energy behavior of the real part of the charge-exchange amplitude is examined, using previous results obtained by Meiman. The dispersion approach and the concept of harmonic measure are considered. (L.B.S.)

43059 SYMMETRIES IN STRONG PARTICLE INTERACTIONS BASED ON THE Sp (3). Tiemblo, Alfredo. Anales Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 61: 53-60(Jan.-Feb. 1965). (In Spanish).

A classification of elementary particles based on the Sp(3) group is outlined. The model includes a particle with a baryon number, hypercharge, and isotopic spin of 1, 2, and 0, respectively. (D.C.W.)

43060 CONSISTENCY OF RELATIVISTIC PARTICLE THEORIES. Ekstein, H. (Universite Aix-Marseille, France). Commun. Math. Phys., 1: 6-13(1965).

The consistency of relativistic particle theories with a finite number of degrees of freedom is discussed without recourse to the position operator. A particle is described by a sub-algebra of observables at one time. Homogeneous transformations, including "accelerations," must preserve the identity of particles, and therefore leave the sub-algebras invariant. It is shown that with this assumption only non-interacting particle theories are compatible with the principle of relativity, in quantum as well as classical mechanics. (auth)

43061 UPPER AND LOWER LIMITS FOR THE NUMBER OF BOUND STATES IN A GIVEN CENTRAL POTENTIAL. Calogero, F. (Universita, Rome; Istituto Nazionale di Fisica, Rome). Commun. Math. Phys., 1: 80-8(1965). Rome).

Upper and lower limits for the number of bound states in a given central potential are obtained. They imply that for strongly attractive potentials the number of bound states of given angular momentum increases as the square root of the strength of the potential. (auth)

43062 ITERATED CROSSED BOX DIAGRAM IN THE COMPLEX ANGULAR MOMENTUM PLANE AND BETHE-

SALPETER EQUATION. Martinis, M. (Imperial Coll. of Science and Tech., London). Commun. Math. Phys., 1: 112-26(1965).

The analytic properties of the iterated crossed box diagram are considered in the complex angular momentum plane by using the partial-wave Bethe-Salpeter equation. It is shown that the kernel of the Bethe-Salpeter equation is of the Hilbert-Schmidt type in the domain $\Delta(l,s) \equiv \{l,s;\ \mathrm{Re}\, l > -\frac{1}{2};\ \mathrm{Im}\, s \neq 0\}$, having a simple pole at $l = -1$. This pole produces in the whole amplitude a singularity found by Gribov and Pomeranchuk since the kernel is not of finite rank. (auth)

43063 ON A CLASS OF GENERALIZED POINCARE GROUPS: INHOMOGENEOUS SL(n,C). Bacry, H.; Kihlberg, A. (Chalmers Univ. of Tech., Goteborg; CERN, Geneva). Commun. Math. Phys., 1: 150-8(1965).

A certain class of non semi-simple Lie groups ISL(n,C), based on SL(n,C), is investigated. Its Lie algebra and invariants are determined. The connection between ISL(2,C) and the Poincaré group is discussed. (auth)

43064 LOCAL INVARIANCE AND GENERALIZATION OF THE INHOMOGENEOUS LORENTZ TRANSFORMATIONS. Ivanitskaya, O. S. (Inst. of Physics, Academy of Sciences, Belorussian SSR). Dokl. Akad. Nauk BSSR, 9: 88-90(Feb. 1965). (In Russian).

The Lorentz covariant field theory of elementary particles may be extended to a general covariant form by substituting the variation principle for one that is invariant with respect to infinitely small ten-parameter Lorentz transformations. On this basis, the principle of local invariance is applied to cases in which the galilean coordinates are replaced by a field coordinate system. The characteristics of the space-time inhomogeneity are reviewed, deriving a construction that leads to rotation and translation by generalizing the 10-parameter Lorentz transformations while conserving the individuality of the ten parameters. (TTT)

43065 MAGNETIC MOMENT OF A PARTICLE WITH VARIABLE SPIN $\frac{1}{2} - \frac{3}{2}$. Fedorov, F. I.; Lobko, S. I. (Belorussian State Univ., USSR). Dokl. Akad. Nauk BSSR, 9: 147-51(Mar. 1965). (In Russian).

A particle with a variable spin of $\frac{1}{2}$ to $\frac{3}{2}$ and two rest masses m_1 and m_2 is described by a first-order equation containing square matrices of the 20th order. The magnetic moment of the particle in various mass states is considered by using a nonrelativistic approximation. An expression for the magnetic moment of a particle with spin $\frac{1}{2}$ is obtained by the use of projection operators. The results show that the magnetic moment of a particle in a lower spin state differs from the magnetic moment of a Dirac particle with spin $\frac{1}{2}$. The additional contribution to the magnetic moment is due to the presence of another mass state and depends on the mass difference of both states. Similarly an additional component is found for a particle with spin $\frac{3}{2}$. If the difference in mass states is not small, this component will give an additional interaction with the electromagnetic field that depends directly on the potential $\vec{A}$, and not on the field $\vec{H}$. This additional term is due to the presence of a lower mass state in the particle. (TTT)

43066 SOME PROPERTIES OF QUASI-ATOM e^+H. Hoang, Din Wang (Belorussian State Univ., USSR). Dokl. Akad. Nauk BSSR, 9: 152-5(Mar. 1965). (In Russian)

A quasiatom of a proton + electron + positron is formed when a positron strikes a hydrogen atom. Although the e^+H system is unstable and can decay to a positron and a proton, an explanation of the properties of this quasiatom is of definite interest. The nonrelativistic Schroedinger equation is written for the energy of the system. Corrections are added for the mass and for motion of the nucleus. The energy correction for motion of the nucleus is $\epsilon_2 = 1.02 \times 10^{-4}$ atom units or 22.41 cm^{-1}. Bethe obtained a value of $\epsilon_2 = 4.79$ cm^{-1} for helium. The ratio of $\epsilon_2(He^4)$ to $\epsilon_2(e^+H)$ is approximately equal to the reciprocal ratio of their masses: $\epsilon_2(He^4)/\epsilon_2(e^+H) = M(e^+H)/M(He^4) = 0.24$. The electron density was calculated in the form: $Q = Aa_0^{-3} = \text{const}$. Here a_0 is the first Bohr radius. The values of A are 1.83 for helium, 0.104 for H^-, and 0.0176 for e^+H. The electron density is low because the positron strongly attracts the electron, and consequently the wave function of the electron is smeared over a large region. The molar diamagnetic susceptibility was calculated to be $-57.2 \times 10^{-6} cm^3$. This value exceeds the corresponding value for H ($-2.93 \times 10^{-6} cm^3$) by a factor of 20, the value for He ($-1.92 \times 10^{-6} cm^3$) by a factor of 28, and the value for H^- ($-1.97 \times 10^{-6} cm^3$) by a factor of 3. This result indicates that the hydrogen atom is strongly polarized in the presence of a positron. (TTT)

43067 POLARIZATION EFFECTS IN THE PRODUCTION OF PARTICLES IN COLLIDING BEAM EXPERIMENTS. Baier, V. N.; Fadin, V. S. (Novosibirsk State Univ., USSR). Dokl. Akad. Nauk SSSR, 161: 74-7(Mar. 1, 1965). (In Russian).

To estimate the influence of electron polarization on the fundamental two-particle processes occurring during annihilation of an electron-positron pair, the cross sections for the production of pairs of pions, muons, nucleons, and vectons by polarized electrons and positrons were calculated. The polarization is produced when the electrons move in a magnetic field and radiate. The calculations show that polarization of the initial electrons and positrons causes the cross sections of two-particle annihilation to be appreciably deformed compared with the cross sections of the process for nonpolarized particles. Such deformation must be taken into account in experiments with colliding beams. On the other hand, experiments with initially polarized particles yield no new information on the form factors, compared with experiments with unpolarized particles. To obtain new information on the form factors it is essential to measure the polarization of the final particles. (ATD)

43068 UNSTABLE QUARKS AND THEIR DETECTION. Zel'dovich, Ya. B. JETP Letters (USSR)(English Transl.), 1: 103-4(May 15, 1965).

A scheme is proposed in which all fundamental particles have integral charges. It is assumed that there is a protobaryon—a boson with baryon number 1, charge 1, spin 0, and strangeness 0. The quarks have a baryon number 0 and spin $\frac{1}{2}$, and the charge of the proton quark is +1, while n and Λ are neutral. Quarks can decay into leptons through currents of the type $(p\nu)$, (ne), $(n\mu)$, (Λe), and $(\Lambda\mu)$. The observation of the track of the proton quark and the decays of quarks are considered, together with the structure of baryons. (D.C.W.)

43069 MIRROR REFLECTION SYMMETRY IN THE CASE OF THE SU(3) GROUP. Jucys, A. P.; Karocene, A. V.; Alishauskas, S. I. (Vilnius State Univ., USSR; Inst. of Physics and Mathematics, Academy of Sciences, Lithuanian SSR). JETP Letters (USSR)(English Transl.), 1: 112-14(May 15, 1965).

The possibility of introducing the symmetry of mirror reflection into the theory of representations of the SU(3) group is demonstrated, together with the practical utility of the corresponding symmetry properties for the calculation of the Clebsch–Gordan coefficients. (D.C.W.)

43070 SU(3) x SU(3) SYMMETRY AND THE BARYON-MESON COUPLING CONSTANTS. Volkov, D. V. JETP Letters (USSR)(English Transl.), 1: 129-31(June 1, 1965).

The relations between the coupling constants of a unitary octet of baryons with octets of pseudoscalar and singlet vector mesons are investigated under the assumption that the breaking of the SU(6) symmetry for a vertex function with three external lines has a kinematic nature and is due to the presence of two independent four-dimensional energy-momentum vectors. (D.C.W.)

43071 HADRON DECAYS OF BARYONS IN THE $\tilde{U}(12)$ SYMMETRY SCHEME. Gedalin, E. V.; Kancheli, O. V.; Matinyan, S. G. (Inst. of Physics, Academy of Sciences, Georgian SSR). JETP Letters (USSR)(English Transl.), 1: 131-3(June 1, 1965).

Hadron decays of hyperons were investigated in the

$\tilde{U}(12)$ symmetry scheme. It was found that the decays $\Omega \rightarrow \Lambda K^-$ and $r \rightarrow \Xi\pi$ proceed with conservation of parity. The parity-conserving amplitudes of hadron decays of baryons were then studied. (D.C.W.)

43072 CONCERNING ONE MECHANISM OF CP-INVARIANCE VIOLATION. Terent'ev, M. V. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Letters (USSR)(English Transl.), 1: 138-41(June 1, 1965).

The decay of mesons (K_1) and (K_2) is discussed under the assumption that the diagonal states are $K_s = K_1 \equiv K + \bar{K}$ and $K_L = K_2 \equiv K - \bar{K}$ (K_s and K_L are the short- and long-lived components, respectively) and that CP parity is not conserved only in decay processes. (D.C.W.)

43073 CONCERNING ONE SINGULARITY OF HIGH-ENERGY JETS IN NUCLEAR EMULSIONS. Gerasimova, N. M. (Moscow State Univ.). JETP Letters (USSR)(English Transl.), 1: 143-5(June 1, 1965).

It is shown that the presence of a relativistic meson (π), moving backward in the laboratory frame, can serve as a criterion for the selection of jets generated in nuclear emulsions by the Landau hydrodynamic process. (D.C.W.)

43074 REDUCTION OF REPRESENTATIONS OF SU_{m+n} WITH RESPECT TO THE SUBGROUP $SU_m \otimes SU_n$. Hagen, C. R. (Univ. of Rochester, N. Y.); Macfarlane, A. J. J. Math. Phys. (N. Y.), 6: 1366-71(Sept. 1965). (NYO-3399-11).

A direct and rapid method is described for the reduction of representations of the special unitary group SU_{m+n} with respect to its $SU_m \otimes SU_n$ subgroup. The technique is illustrated by specific reference to the case of SU_6 and its $SU_2 \otimes SU_4$ subgroup in the context of the recent extension of Wigner's (SU_4) supermultiplet theory into the domain of particle physics. A tabulation of results is given for a slight generalization of this case where reduction is carried out with respect to $U_1 \otimes SU_2 \otimes SU_4$. (auth)

43075 ON THE POSSIBILITY OF RELATING INTERNAL SYMMETRIES AND LORENTZ INVARIANCE. Itzykson, Calude (Stanford Univ., Calif.). J. Math. Phys. N. Y.), 6: 1381-6(Sept. 1965).

The possibility that the inhomogeneous Lorentz group is only a subgroup of a larger Lie group G of symmetries for strong interaction physics is investigated. The discussion is restricted to the Lie algebra $\mathcal{G}$ of G. It is assumed that the remaining generators A_i of G commute with the generators of translations P^λ which build the ideal $\mathcal{I}$ in $\mathcal{G}$. It is then shown that the A_i generate an ideal in $\mathcal{G}$ modulo $\mathcal{I}$. If this ideal is semi-simple, then $\mathcal{G}$ breaks up in a direct sum $\mathcal{G} = \mathcal{P} \oplus \mathcal{A}$, where $\mathcal{P}$ is isomorphic with the Lie algebra of the inhomogeneous Lorentz group and $\mathcal{A}$ is semisimple. (auth)

43076 EXPERIMENTAL OBSERVATION OF ANTIDEUTERON PRODUCTION. Massam, T.; Muller, Th.; Righini, B.; Schneegans, M.; Zichichi, A. (CERN, Geneva). Nuovo Cimento (10), 39: 10-14(Sept. 1, 1965).

Results showing the existence of antideuterons in the proton-beryllium production process are reported. (auth)

43077 THE PRODUCTION AND ANNIHILATION OF ANTINEUTRONS IN AN EMULSION STACK. Khan, N. A.; Major, J. V. (Univ. of Durham, Eng.). Nuovo Cimento (10), 39: 15-26(Sept. 1, 1965).

Antineutrons were produced by the charge exchange of antiprotons in an emulsion stack and their annihilations observed in the same stack. The cross section for production is estimated to be (17 ± 6) mb for antiprotons at a mean energy of 125 Mev. The mean multiplicity, the mean energy of the secondary mesons, and the star sizes of the annihilations of antineutrons are very similar to those for antiprotons. (auth)

43078 THE ROLE OF OPE MECHANISM IN BINDING THE ω-MESON. Kamal, A. N. (Univ. of Alberta, Edmonton). Nuovo Cimento (10), 39: 126-41(Sept. 1, 1965).

The role of the OPE mechanism in binding a $\pi\rho$ system to produce the ω meson is investigated. It is found that the OPE mechanism produces a large repulsion in the $I = 0$, $J^P = 1^-$ state. Since the exchanged pion can become real, the contribution of the real-pion-exchange (RPE) mechanism is carefully investigated. It was found that the contribution of the RPE mechanism to the force is much smaller than that of the virtual-pion-exchange mechanism. (auth)

43079 ANALYTIC PROPERTIES OF PARTIAL-WAVE AMPLITUDES FOR PRODUCTION PROCESSES. Cordes, J. G. (Cambridge Univ., Eng.). Nuovo Cimento (10), 39: 157-68(Sept. 1, 1965).

The singularities present on the physical sheet in a partial-wave projection of the five-point function, due to normal thresholds in crossed channels, are determined. The problem of obtaining cut-plane analyticity in a single variable for the partial-wave amplitude is discussed. (auth)

43080 ANALYSIS OF INELASTIC PROTON-PROTON INTERACTIONS IN THE 1 TO 10 Gev ENERGY RANGE. Ferrari, E. (Cern, Geneva); Gennarini, S.; Lariocia, P. Nuovo Cimento (10), 39: 169-85(Sept. 1, 1965).

Different experimental spectra relevant to inelastic proton-proton interactions, at incident energies between 1 and 10 Bev, are compared with the predictions of the one-pion-exchange (OPE) model, by taking into account the production of one and two pions. This analysis gives a further confirmation of the validity of the OPE model below 3 Bev; with increasing energy, it is found that the model deteriorates rapidly, and that other effects have to be taken into account. However, the behavior of the spectra at high energy seems to depend critically on the isospin of the exchanged system and may be difficult to describe in terms of the pictures currently used for high-energy inelastic interactions. (auth)

43081 AN N/D CALCULATION OF THE $J = 3/2$, $T = 3/2$ π N PHASE-SHIFTS FROM THE POSITION AND WIDTH OF THE N* RESONANCE. Majumdar, Rabi (Univ. of Delhi). Nuovo Cimento (10), 39: 186-9(Sept. 1, 1965).

An N/D calculation of the $J = 3/2$, $T = 3/2$ pion-nucleon phase shifts is performed with the position and width of the $J = 3/2$, $T = 3/2$ N* resonance as the only input parameters. The correct phase shift at the resonance point is thereby guaranteed, and the distant phase shifts are determined as an extrapolation. The results are in good agreement with experiment in the energy region up to ~225 Mev of pion laboratory energy. (auth)

43082 SU_3 AND THREE-PARTICLE STATES. Murtaza, G. (Imperial Coll. of Science and Tech., London). Nuovo Cimento (10), 39: 195-205(Sept. 1, 1965).

Some relations between the crossing matrices and 6j-symbols are derived. The SU_3 symmetry scheme is then applied to the $N\pi\pi$ system and, by inspecting the relevant (generalized) 6j-symbols, some qualitative conclusions concerning the potentials in the various channels are reached. (auth)

43083 DYNAMICAL MODEL OF THE Y_0^* (1405) RESONANCE. Das, Tapaskumar (Univ. of Pennsylvania, Philadelphia); Mahanthappa, K. T. Nuovo Cimento (10), 39: 206-15(Sept. 1, 1965).

The observed Y_0^* (1405 Mev) resonance which decays predominantly into $\Sigma\pi$ is assumed to be in $s_{\frac{1}{2}}$, $I = 0$ state. Its mass and width as well as the coupling constant $g_{Y_0^*N\bar{K}}$ are calculated self-consistently in a two-channel problem involving $\Sigma\pi$ and $\bar{K}N$. Only baryon exchanges are used. The left-hand cut of the $\Sigma\pi$ channel is approximated by two effective-range poles. The calculated mass and width of the Y_0^* resonance are in fair agreement with the observed values. (auth)

43084 GENERALIZED REACTION FORCES FROM POTENTIAL SCATTERING. Smith, W. E. (Univ. of New South Wales, Sydney). Nuovo Cimento (10), 39: 216-23(Sept. 1, 1965).

The forces exerted by momentum reaction from the potential scattering of nonrelativistic particles are in-

vestigated. By application of the adiabatic principle to the variation of a parameter x, the average generalized force $\bar{F}_x$ is expressed as a surface integral of the wave function and its variation. The surface integral is reduced to a form involving particle-flux amplitudes and derivatives of the collision matrix with respect to x. In this form the results are the same as for radiation-pressure forces in electromagnetism or acoustics. Some implications arising from an identification of the reaction forces with radiation pressures of a Schroedinger field are outlined. (auth)

43085 AN INTEGRAL REPRESENTATION FOR THE PROPAGATION FUNCTION OF AN ELECTRON IN A HOMOGENEOUS MAGNETIC FIELD. Hughes, J. W. B. (University Coll. of Science and Tech., London). Nuovo Cimento (10), 39: 224-34(Sept. 1, 1965).

The Dirac equation for an electron in a homogeneous magnetic field is considered, and the Wronskian of the system defined. It is shown that, as a function of the energy, the inverse of the Wronskian has simple poles whenever the energy takes on an eigenvalue of the system, and that its residues at these points are proportional to the inverses of the normalization integrals for the corresponding eigensolutions of the Dirac equation. This property of the Wronskian is used to obtain an integral representation for the electron's propagation function. (auth)

43086 SINGULAR INTEGRAL EQUATIONS, ASYMPTOTIC BEHAVIOR AND ANALYTICITY IN THE COUPLING CONSTANT. de Alfaro, V. (Inst. for Advanced Study, Princeton, N. J.); Predazzi, E. Nuovo Cimento (10), 39: 235-45(Sept. 1, 1965).

The inverse Mellin transform is exploited in connection with linear singular integral equations and nonanalyticity in the coupling constant at the origin. A difference integral equation in the transforming variable is obtained, by which the asymptotic behavior of the solution near the singular point can be discussed. (auth)

43087 VECTOR MESONS AND COMPLEX ANGULAR MOMENTUM. [PART] II. Ahmed, K.; Martinis, M. (Imperial Coll. of Science and Tech., London). Nuovo Cimento (10), 39: 246-51(Sept. 1, 1965).

It is shown that the leading singularities in the complex angular momentum plane for the process $\pi^+\pi^- \to \pi^+\pi^-$ mediated by the vector mesons occur near $l = 1$. Only sixth-order Feynman graphs are considered. It is then found that the analytic part of the sixth-order continued partial-wave amplitude has a purely imaginary contribution near $l = 1$. The singular part of the amplitude when iterated gives two Regge poles in the neighborhood of $l = 1$. (auth)

43088 CLASSIFICATION OF CHARGE AND HYPERCHARGE FUNCTIONS FOR n K-MESONS. Proriol, J. (Institut de Physique Nucleaire, Lyon). Nuovo Cimento (10), 39: 252-5(Sept. 1, 1965).

For each partition of n ($0 \leq n \leq 5$), the quantum numbers of charge and hypercharge are given for states of n kaons. An additional quantum number connected with hypercharge is introduced and used to remove the degeneracy arising in certain states. (auth)

43089 THE ANOMALOUS MAGNETIC MOMENT OF THE ELECTRON AND THE PROTON. Mann, R. A. (Univ. of Dayton, Ohio); Schwebel, S. L. Nuovo Cimento (10), 39: 256-69(Sept. 1, 1965).

The Schwebel-Sachs self-consistent field theory of quantum electrodynamics is used to calculate the anomalous magnetic moment of the electron without recourse to renormalization and perturbation techniques. It was shown previously that the basic postulate that the laws of nature must be described in terms of field variables which may be associated only with elementary interactions, led to an elimination of the self-interactions that plagued classical theory and to a new electromagnetic interaction, the dual Lorentz interaction, which has the form $\rho H - (1/c)(j \times E)$. It is shown that this dual Lorentz interaction gives rise to an additional magnetic interaction gives rise to an additional magnetic interaction which may be interpreted as the anomalous magnetic moment. The anomaly is found to be $A = 2mcq/\hbar$ where g is the coupling constant of the field-current interaction representing the dual Lorentz interaction and has the dimension of length. The value of g obtained from previous Lamb shift calculations is used to show that $A = 1.087 \cdot 10^{-3}$. The small discrepancy between this value and that of the free relativistic electron measurement is attributed to approximations made in the Lamb shift calculations. Recalculation of g on the basis of the experimental value of the anomaly yields $g = 2.24 \cdot 10^{-14}$ cm. Calculation of the proton anomaly gives $A = 2.14$ compared to the magnetic resonance value of 1.79. It would be of interest and value to determine the magnetic moment of the proton under the same experimental conditions which determine the magnetic moment of the free electron. (auth)

43090 LOW-ENERGY D-WAVE π-π SCATTERING PHASE SHIFTS. Rae, H. C. (Univ. of Durham, Eng.). Nuovo Cimento (10), 39: 270-8(Sept. 1, 1965).

A solution of the D-wave $\pi\pi$ scattering inverse amplitude dispersion relations is obtained which satisfies crossing on the nearby left-hand cut. The D-wave $\pi\pi$ phase shifts are calculated at low energies for isospin 0 and 2. (auth)

43091 NOTE ON THE SCALAR BOSON. Furuichi, S. (Rikkyo Univ., Tokyo); Yonezawa, M. Nuovo Cimento (10), 39: 279-86(Sept. 1, 1965).

Discussions are given about the observability of the isoscalar scalar boson required by the one-boson exchange model of N-N scattering and its effects on the K-meson decays. (auth)

43092 A RECIPROCAL BOOTSTRAP MECHANISM FOR QUARKS. Wazed, A. (Univ. of Durham, Eng.). Nuovo Cimento (10), 39: 292-9(Sept. 1, 1965).

P-wave quark-pseudoscalar meson scattering is considered, and the appropriate crossing matrix is calculated, which shows a reciprocal bootstrap relation between quarks, Q, and some other particles, Q*, having the baryon number $1/3$, spin $3/2$, and belonging to the 15-dimensional representation of SU_3. The determinantal method is used to obtain self-consistent values which are $M_Q \simeq 2429$ Mev, $M_Q^* \simeq 5251$ Mev $g_1^2 \simeq 22$, $g_3^2 \simeq 32$, where M_Q, M_Q^* and g_1^2, g_3^2 are respectively the masses and couplings of Q and Q*. (auth)

43093 THE ABSORPTIVE CORRECTION TO THE PERIPHERAL MODEL. Squires, E. J. (Univ. of Durham, Eng.). Nuovo Cimento (10), 39: 300-6(Sept. 1, 1965).

A previously discussed random phase N/D model is used to calculate a modified formula for correcting the peripheral model for absorptive effects. (auth)

43094 HELICITY REPRESENTATIONS FOR INHOMOGENEOUS SL(6,C) GROUPS. Ruehl, W. (CERN, Geneva). Nuovo Cimento (10), 39: 307-15(Sept. 1, 1965).

The concept of helicity operators known from the inhomogeneous Lorentz group is generalized to inhomogeneous SL(6,C) groups. These operators are used to classify basic elements of unitary representations. (auth)

43095 $Z_1 = 0$ AND THE CONDITIONS FROM THE N/D METHOD. Akiba, T.; Saito, S.; Takagi, F. (Tohoku Univ., Sendai). Nuovo Cimento (10), 39: 316-30(Sept. 1, 1965).

$Z_1 = 0$ as a condition for a particle being composite is compared with the condition $D(m^2) = 0$ from the N/D method. Previously, Lee et al. proved the equivalence between the composite particle defined as the $Z_3 = 0$ limit of an elementary particle and the one defined by the condition $(N(s)/(dD(s)/ds))_{s=m^2} = -g^2$ in the N/D method. The compositeness of a particle is restricted further by $Z_1 = 0$ and $D(m^2) = 0$, respectively, and the equivalence between the composite particles defined by Salam's conditions $Z_3 = Z_1 = 0$ and by the unsubtracted N/D equations is proved. The equivalence is proved for a particle in the S-state composed of two spin-zero particles in the approximation

of considering only two-particle intermediate states and under the assumptions: i) the scattering amplitudes have at most one particle pole below the threshold of scattering; ii) the Levinson theorem in its original sense is satisfied; iii) the generalized potential is such that there exists an amplitude t(s) determined through the unsubtracted N/D equations, and t(s) has a pole. For the proof the method of Blanckenbecler et al. is used to obtain a general form of scattering amplitudes which have the given discontinuity on the left-hand cut and satisfy i), ii), and iii). Nonuniqueness of the propagation function and the vertex function, as well as Z_3 and Z_1, are investigated in detail. (auth)

43096 RENORMALIZED PERTURBATION SERIES OF ELECTRODYNAMICS FROM S-MATRIX THEORY. Barut, A. O.; Blade, R. A. (Univ. of Colorado, Boulder). Nuovo Cimento (10), 39: 331-43(Sept. 1, 1965).

Electromagnetic processes are evaluated using extended unitarity and analyticity of the scattering amplitude. If e^2 is assumed to be small, a successive pole approximation of the unitarity relation and appropriate approximative analyticity assumptions to every order in e^2 are shown to be equivalent to renormalized Feynman perturbation theory. (auth)

43097 THE GENERALIZED KEMMER EQUATION. Castell, L. (Trinity Coll., Dublin). Nuovo Cimento (10), 39: 344-6(Sept. 1, 1965).

The generalized field theoretic concept of an elementary particle as a relativistic rotator is used to consider the 5-dimensional Kemmer equation to which different angular momentum states are intrinsically coupled. The resulting energy-level trajectories are compared with the simple classical model of a rotating solid sphere. (M.J.T.)

43098 ROTATION GROUPS AND COMPOSITENESS. Cook, P. A. (Univ. of Manchester, Eng.). Nuovo Cimento (10), 39: 347-9(Sept. 1, 1965).

The hypothesis that the vector mesons are generated by a bootstrap mechanism arising from exchange of vector mesons in the scattering of pseudoscalar mesons is examined with respect to R(n) invariance, for the case of nondegenerate masses. It is pointed out that the first-order mass splittings among the vector mesons are simply related to those among the pseudoscalar mesons; thus the mass relations can not be chosen independently, and the bootstrap approximation proposed is not a good one. (M.J.T.)

43099 ON THE TWO-BODY DECAYS OF THE HIGHER BOSON RESONANCES. Costa, G. (Istituto di Fisica Galileo Galilei, Padua; Istituto Nazionale di Fisica Nucleare, Padua); Tonin, M.; Sartori, G. Nuovo Cimento (10), 39: 352-7(Sept. 1, 1965).

A possible "boosting" is proposed for the P-wave two-quark model in which the higher boson resonances are assigned to SU(6) multiplets according to a 105-dimensional representation, behaving like 35 under SU(6) and like P-wave under orbital rotations. An SU(6) × R(3) structure is used, and it is assumed that, in the absence of the spin-orbit interaction, the boosting is carried out independently on the SU(6) part and on the angular momentum (R(3)) part, giving a U(12) × $\mathcal{V}$ structure. Effective interaction lagrangians are obtained and used to evaluate the two-body decay widths of the higher bosons. Results indicate a fairly good agreement with the experimental values if a small symmetry-breaking interaction term is included. (M.J.T.)

43100 VECTOR FIELDS OF DEFINITE SPIN. Pocsik, G. (Lorand Eotvos Univ., Budapest). Nuovo Cimento (10), 39: 358-60(Sept. 1, 1965).

The problem of introducing a vector field of single definite spin starting from a vector field coupled to a nonconserved current is examined. A new vector field having single spin equal to unity can be introduced by subtracting the current from the original field. The new field is divergenceless. It can be shown that the S-operator remains invariant under this transformation. The lagrangian expressed in terms of the new variables shows clearly the nonrenormalizability. In general, the equal-time commutator of the fermion field with the new vector field does not vanish. (M.J.T.)

43101 VERY-HIGH-ENERGY e^+-e^- SCATTERING ON FINITE QUANTUM FIELD THEORY. Ingraham, R. L. (New Mexico State Univ., University Park). Nuovo Cimento (10), 39: 361-4(Sept. 1, 1965).

The theoretical cross section for e^+-e^- scattering is given in a particular finite field theory which results from building quantum field theory over space-time treated as random rather than sharp co-ordinates. The frame-dependence in this field theory—that cross sections measured in the cms are different from those measured in the laboratory system—is discussed. (M.J.T.)

43102 ABSORPTIVE CORRECTION TO THE INELASTIC AMPLITUDE IN THE DAMPING THEORY OF STRONG INTERACTIONS. Yonezawa, M. (Australian National Univ., Canberra). Nuovo Cimento (10), 39: 365-7(Sept. 1, 1965).

The absorptive correction to the Born amplitude in the one-meson-exchange model of inelastic interactions is treated by replacing the partial-wave amplitude by $B^J_{12} \to (2/B^J_{12})[1 \pm \sqrt{1 - \tfrac{1}{4}(1 + S^J_{11})B^J_{12}(1 + S^J_{22})}]$, where B^J_{12} is the uncorrected Born amplitude for the transition $1 \to 2$, and S^J_{11} and S^J_{22} are the S-matrices of the elastic scattering in states 1 and 2 respectively. Results for the two-channel case of the damping theory are compared for this correction and a simpler one proposed previously. (M.J.T.)

43103 NUCLEON STRUCTURE AND HIGH-ENERGY COLLISIONS. Carriere, E.; Armoudian, G. A.; Ito, D. (Louisiana State Univ., Baton Rouge). Nuovo Cimento (10), 39: 368-71(Sept. 1, 1965).

Properties of high-energy π-N and N-N collisions are examined with respect to their dependence on the nature of the particles involved. The particle-structure dependence of the total cross sections and the particle-structure independence of the diffraction-scattering optical radius, momentum transfer, and properties of secondary particles are explained using the Weizsacker-Williams approximation and assuming the dominant mechanism in particle production is the interaction between cloud pions of the nucleons. The elastic cross sections are calculated and compared with experiment. (M.J.T.)

43104 THE DECAYS $\varphi^0 \to \pi^+\pi^-\gamma$, $\omega^0 \to \pi^+\pi^-\gamma$, S-WAVE RESONANCES AND C INVARIANCE. Yellin, J. (Univ. of Chicago). Nuovo Cimento (10), 39: 377-80(Sept. 1, 1965). (COO-264-266).

The decays $(\varphi^0, \omega^0) \to \pi^+\pi^-\gamma$ are considered in order to obtain information on the π-π interaction. It is assumed that only the s-wave is present for the C-conserving interaction. Expressions for the decay rate of a final-state π-π 0^+ resonance and for the photon spectrum are obtained; the rates are evaluated numerically for the ω^0 and φ^0 for resonance masses of 300 to 800 Mev. The effect of C violation on the decay amplitudes and photon spectrum is discussed. The derived energy spectra for the pions with and without C conservation are shown. (M.J.T.)

43105 EXCHANGE MECHANISMS FOR THE REACTIONS $\pi^-p \to \rho^0 n$ AND $\pi^-p \to \rho^- p$ AT 2.0 Gev/c. Gutay, L.; Lannutti, J. E.; Tuli, S. K. (Florida State Univ., Tallahassee). Nuovo Cimento (10), 39: 381-3(Sept. 1, 1965).

The Gottfried-Jackson analysis was applied to a study of the exchange mechanism and absorption effects in the final state for the reactions $\pi^-p \to \rho^0 n$ or $\rho^- p$. The analysis was based on 1084 events in a bubble chamber exposed to a 2.0-Bev/c pion beam. The Treiman-Yang distributions and the cos θ distributions including and subtracting the N^*_{33} events, with fits to the Gottfried-Jackson expressions, are given for the two reactions. Results of calculations of the spin space density matrix elements are compatible with a ρ production mechanism via the exchange of a pion and show no effects due to the N^*_{33}. (M.J.T.)

43106 SEARCH FOR B = 2, S = 0 RESONANCES IN pp COLLISIONS AT 5.5 Gev/c. Alexander, G.; Kidron, N.;

Reuter, B.; Shapira, A.; Yekutieli, G. (Weizmann Inst. of Science, Rehovoth, Israel). Nuovo Cimento (10), 39: 384-7(Sept. 1, 1965).

Results of a search for B = 2, S = 0 resonance states formed in p-p collisions at 5.52 Bev/c are presented. A sample of 1020 four-prong and 75 six-prong events in a bubble chamber was studied for the formation of a possible $D_{21}(I = 2, J = 1)$ in $pp \rightarrow D_{21} + \pi$ ($D_{21} \rightarrow NN\pi$) and in $pp \rightarrow D_{21} + \pi\pi(D_{21} \rightarrow NN\pi)$ and a possible $D_{30}(I = 3, J = 0)$ in $pp \rightarrow D_{30} + \pi\pi(D_{30} \rightarrow NN\pi\pi)$. Branching ratios for the various D_{21} and D_{30} charge states and for the final-state configurations detectable in this experiment are given. Measured invariant mass distributions for the final state protons and pions are shown. No evidence is found for the B = 2, S = 0 resonance. (M.J.T.)

43107 ON COMMUTATION RELATIONS OF TENSOR OPERATORS. Schwegler, H. (Technische Hochschule, Darmstadt, Ger.). Nuovo Cimento (10), 39: 398-400 (Sept. 1, 1965).

The case of a unitary vector space being a representation space U(j) with angular momentum j of the 3-dimensional rotation group or a representation space of a subgroup of the rotation group is considered. Then a complete set of orthogonal operators, characterized by their behavior under rotations, may be used in the corresponding Liouville space. The commutators of these irreducible tensor operators are studied. The operators are written as polynomials of the angular momentum operators using the operator equivalence based on the Wigner-Eckart theorem. (M.J.T.)

43108 PROTON-PROTON COLLISION AT 418 Mev k.e. Focardi, S. (Universita, Bologna); Saporetti, F.; Bertolini, E. (and others). Nuovo Cimento (10), 39: 405-8(Sept. 1, 1965).

Studies were made of p-p interactions at 418 Mev in a hydrogen bubble chamber. Total cross sections and ems angular distributions are shown for the four possible final-state interactions—pp, $d\pi^+$, $pn\pi^+$, and $pp\pi^0$. The Dalitz plot for the $pn\pi^+$ events is given. (M.J.T.)

43109 MEASUREMENT OF SMALL CHARGES IN MACROSCOPIC AMOUNTS OF MATTER: DISCUSSION OF A PROPOSED EXPERIMENT AND DESCRIPTION OF SOME PRELIMINARY OBSERVATIONS. Becchi, C.; Gallinaro, G.; Morpurgo, G. (Universita, Genoa; Istituto Nazionale di Fisica Nucleare, Genoa). Nuovo Cimento (10), 39: 409-12(Sept. 1, 1965).

A method for measuring small charges in macroscopic amounts of matter is suggested, with the intent of proving or disproving the existence of the nonintegrally charged quarks. The method is based on levitation of a diamagnetic particle—a solid grain or a water droplet—in a magnetostatic field between poles of appropriate shape and measuring the displacement of the particle under a horizontal electric field. Preliminary observations with graphite and bismuth grains are described, and the conditions which must be satisfied to get a precision of better than $\frac{1}{3}$ the electron charge are discussed. (M.J.T.)

43110 DIVISION OF NUCLEAR PHYSICS, REPORT. Weksler, W. I. Osteuropa Naturw., 8: 93-7(Dec. 1964). (In German).

Some research in nuclear physics and elementary-particle physics is briefly reviewed, including work on high-energy accelerators ($10^{11} - 10^{12}$ ev) and new principles of particle acceleration. Notably, heavy nuclei with extremely short lifetimes indicate a previously unreported kind of spontaneous decay in nuclei with very large angular momenta. (D.C.W.)

43111 THE $\omega \rightarrow \pi^0 + \gamma$ DECAY IN THE QUARK MODEL. Thirring, W. E. (Universitaet, Vienna). Phys. Letters, 16: 335(June 1, 1965).

A relativistic calculation of the width of the decay $\omega \rightarrow \pi^0 + \gamma$ is summarized in which a transition current proposed by Fulton and Wess (Phys. Letters, 15: 177 (1965)) was used. The results show that the experimental value for the width is obtained if it is postulated that the transition moment between states of the same energy is that of the static quark model. (D.C.W.)

43112 ANOMALOUS INCREASE IN THE LIFETIME OF POSITRONS IN TEFLON AT LOW TEMPERATURES. Kelly, T. M.; Canter, K. F.; Roellig, L. O. (Wayne State Univ., Detroit). Phys. Letters, 18: 115-16(Aug. 15, 1965).

The long component lifetime of positrons from a ^{22}Na source annihilating in teflon was measured at 1.25, 4.2, 77, and 277°K. The lifetime was observed to decrease with from 277 to 4.2°K; and an anomalous increase was observed at 1.25°K, which is attributed to a very low temperature transition in teflon. (L.B.S.)

43113 EVIDENCE FOR A 1.40 Gev NUCLEON RESONANCE FROM HIGH ENERGY INELASTIC PROTON SCATTERING IN HYDROGEN AND DEUTERIUM. Bellettini, G.; Cocconi, G.; Diddens, A. N.; Lillethun, E.; Scanlon, J. P.; Shapiro, A. M.; Wetherell, A. M. (CERN, Geneva). Phys. Letters, 18: 167-71(Aug. 15, 1965).

The momentum spectra of protons scattered with small inelasticity from hydrogen at angles between 2 and 20 mradian were measured using a proton beam at 10, 19, and 26 Bev/c. A measurement was also made of proton-deuteron scattering at 19 Bev/c. The structure observed in the momentum spectra is discussed in terms of the production of excited nucleon states. In particular, evidence is presented for the excitation of a nucleon resonance of 1.40 Bev. (L.B.S.)

43114 INTERPRETATION OF THE N η STATE AT THE PRODUCTION THRESHOLD AS A $J^P = \frac{1}{2}^-$ RESONANCE. Hendry, A. W.; Moorhouse, R. G. (Rutherford High Energy Lab., Chilton, Berks, Eng.). Phys. Letters, 18: 171-5(Aug. 15, 1965).

Pion-nucleon scattering data are examined in detail together with the η-production cross sections in the vicinity of the η threshold, using a multichannel effective range formalism. It is suggested that the production occurs predominantly in an S-state. The rapid energy variation in the η-production cross-section and the phase shift analyses around the η threshold are explained in terms of a resonance at 20 to 30 Mev above the threshold, at approximately 1510 Mev with a full width of about 100 Mev. An attempt is also made to accommodate the $I = \frac{1}{2}$, $J^P = \frac{1}{2}^-$ resonance in the higher symmetry schemes. (L.B.S.)

43115 $K_2^0 \rightarrow \pi^+\pi^-\pi^0$ DECAY: BRANCHING RATIO AND π^0 ENERGY SPECTRUM. Astbury, P. (CERN, Geneva); Michelini, A.; Verkerk, C.; Verkerk, F.; Beush, W.; Pepin, M.; Pouchon, M. A. Phys. Letters, 18: 175-8 (Aug. 15, 1965).

An analysis was made of 2036 cloud chamber events in search for meson (K_2^0) decays, using the REAP-THRESH-GRIND programs. The results obtained for the branching ratio, $\Gamma(K_2^0 \rightarrow \pi^+\pi^-\pi^0)/\Gamma(K_2^0 \rightarrow \text{all charged})$, and the π^0 energy spectrum are reported. (L.B.S.)

43116 A MEASUREMENT OF THE MEAN LIFE OF THE K_2^0. Astbury, P. (CERN, Geneva); Michelini, A.; Verkerk, C.; Verkerk, F.; Beusch, W.; Pepin, M.; Pouchon, M. A. Phys. Letters, 18: 178-81(Aug. 15, 1965).

Photographs were obtained from a large magnet expansion chamber which was exposed to a neutral K beam at three distances from the internal target, and the relative number of K_2^0 decays at these distances were used to estimate the mean life of the K_2^0. The momentum spectrum was obtained from a sample of $K_2^0 \rightarrow \pi^+\pi^-\pi^0$ decays. The results of the data analysis are reported, from which was obtained a mean life τ of $(61^{+}_{-}\frac{4}{6})$ ns. (L.B.S.)

43117 THE REAL PART OF THE π N FORWARD SCATTERING AMPLITUDE AT HIGH ENERGIES. Hoehler, G. (Universite Aix, Marseille); Baacke, J. Phys. Letters, 18: 181-3(Aug. 15, 1965).

The compatibility of the dispersion relations with experimental data for the real parts of the forward scattering amplitudes and for total cross sections is investigated, using data for total cross sections for π N charge exchange scattering at 2.1 to 7.0 and 6 to 20 Bev/c. (L.B.S.)

43118 ON THE STABILITY OF SPONTANEOUS BREAKDOWN SOLUTIONS. Tarjanne, P. (Univ. of Oulu, Finland). Phys. Letters, 18: 183-5(Aug. 15, 1965).

A superconducting model of elementary particles is presented which shows that the most stable solution for the mass equations for the three basic fermion fields is the case corresponding to a small but finite octet type nondegeneracy. (L.B.S.)

43119 A METHOD FOR THE SEARCH FOR UNSTABLE PARTICLES USING JACOBIAN PEAKS IN ANGULAR DISTRIBUTION. Maglic, B.; Gosta, G. (CERN, Geneva). Phys. Letters, 18: 185-9(Aug. 15, 1965).

The missing-mass method is proposed for scanning the mass spectrum of both bosons or nucleon isobars, in order to observe all resonances produced with similar cross sections with statistical significance and good mass resolution. The method is described for the production of an unstable particle x in the two-body process of the type $a + n \rightarrow n' + x$. (L.B.S.)

43120 SCATTERING LENGTH ANALYSIS OF THRESHOLD PHENOMENA IN THE REACTION $\pi^- + p \rightarrow \eta^0 + n$ AND THE ELASTIC PHASE SHIFT. Uchiyama-Campbell, F. (Univ. of California, San Diego, La Jolla). Phys. Letters, 18: 189-90(Aug. 15, 1965).

Previous experiments on pion-nucleon η-production showed a fairly rapid rise in the production cross section at the threshold, which was attributed to a pole of the S-matrix on unphysical sheets. A scattering length analysis is presented, in which no pole was found. It is concluded that the rising of the inelastic cross section in $\pi N - N\eta$ is not rapid enough to imply a pole near the threshold. (L.B.S.)

43121 ON THE EVALUATION OF THE REAL PART OF THE FORWARD PION-PROTON SCATTERING AMPLITUDE IN A REGGE POLES APPROXIMATION. Sertorio, L.; Toller, M. (Istituto Nazionale di Fisica Nucleare, Rome; Universita, Rome). Phys. Letters, 18: 191-3 (Aug. 15, 1965).

Calculations are made of the ratio of the real to the imaginary part of the forward pion-proton scattering amplitude, using a three poles model which includes a third Pomeranchuk pole. (L.B.S.)

43122 PHASE SHIFTS FOR ELASTIC pp SCATTERING BETWEEN 3 AND 4 Gev/c. Chretien, M. (Brandeis Univ., Waltham, Mass.). Phys. Letters, 18: 194-5(Aug. 15, 1965).

An attempt is made to describe the differential cross section for elastic $\bar{p}p$ scattering using a grey disk model in which the phase shifts and the scattering amplitude are purely imaginary. Poor agreement was found with experiment. The potential model was considered in which the real part of the scattering amplitude and phase shifts are included, and the results show a good fit to the experimental data. (L.B.S.)

43123 ON THE MECHANISM OF LARGE-ANGLE SCATTERING AT HIGH ENERGIES. Alliluev, S. P.; Gershtein, S. S.; Logunov, A. A. (Inst. of High Energy Physics, Serpukhov, USSR). Phys. Letters, 18: 195-6 (Aug. 15, 1965).

It is noted that the mechanism of large-angle scattering in the high-energy region can be considered as scattering to classically forbidden angles as in quantum mechanics. (L.B.S.)

43124 THE REACTION $\pi^- p \rightarrow \eta n$ BETWEEN 3 AND 18 Gev/c. Guisan, O. (CEN, Saclay, France); Kirz, J.; Sonderegger, P. (and others). Phys. Letters, 18: 200-3 (Aug. 15, 1965).

The forward peak of the reaction $\pi^- p \rightarrow \eta n$ was studied in a spark chamber experiment through detection of both photons from the $\eta \rightarrow 2\gamma$ decay mode. Results are reported for the cross sections for the reaction at 2.91, 3.72, 5.9, 9.8, 13.3, and 18.2 Bev/c, and for squared momentum transfers between 0 and around 1(Bev/c)^2. (L.B.S.)

43125 DOUBLE pp-SCATTERING AT 667 Mev. Azhgirey, L.; Kumekin, Yu.; Mescheryakov, M.; Nurushev, S.; Solovyanov, V.; Stoletov, G. (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Letters, 18: 203-6 (Aug. 15, 1965).

An experiment was performed on double $\bar{p}p$-scattering by free protons at 667 Mev, and a phase shift analysis was carried out using polarization values together with the values of the differential cross sections, the total cross section of the $\bar{p}p$ interaction, as well as the total cross section of inelastic processes $\sigma_t(\pi^+ pn)$, $\sigma(\pi + d)$, $\sigma_t(\pi^0 \bar{p}p)$ at 660 Mev and triple scattering parameters. The analysis showed that the data on $\bar{p}p$ scattering near 660 Mev can be expressed with a good reliability by a set of real phase shifts and absorption coefficients. (L.B.S.)

43126 ON THE EXISTENCE OF THE A_1 PEAK IN INTERACTION OF PIONS ON EMULSION NUCLEI AT 17 Gev. Bozoki, G.; Fenyves, E.; Gombosi, E.; Nagy, E. (Central Research Inst. of Physics, Budapest). Phys. Letters, 18: 206-8(Aug. 15, 1965).

An investigation was made of the pion-nucleus interaction of the type $\pi^- + N \rightarrow \pi^- + \pi^- + \pi^+ + N + K\pi^0$ with very low momentum transfer produced by 17.2 Bev negative pions in nuclear emulsions. The effective mass distributions show a peak at about 1 Bev with a half width of 0.2 Bev, which is explained by the diffraction dissociation mechanism of the interaction without assuming a strong production of the A_1 resonance. (L.B.S.)

43127 TWO CONTRIBUTIONS TO THE THEORY OF ANNIHILATION OF POSITRONS IN METALS. I. DETERMINATION OF THE TRUE FERMI SURFACE. Majumdar, Chanchal K. (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev., 140: A227-36(Oct. 4, 1965).

The theory of positron annihilation in metals, including electron-positron and electron-electron interaction, is discussed. It is well known that the Coulomb force of the positron causes very major changes in the motion of the electrons. Nevertheless, it is established that a sharp break in the angular-correlation curve of the two γ rays resulting from the singlet-state annihilation occurs at precisely those angles where it should be expected in the absence of electron-positron interaction. The break is an image of the discontinuity in the momentum distribution present in normal metals. Positron annihilation in metals is therefore a useful tool for the investigation of the true Fermi surface. It is also demonstrated that the slope of the angular-correlation curve at the Fermi momentum is related to the Gaussian curvature of the Fermi surface. (auth)

43128 TWO CONTRIBUTIONS TO THE THEORY OF ANNIHILATION OF POSITRONS IN METALS. II. EFFECTIVE MASS OF THE POSITRON. Majumdar, Chanchal K. (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev., 140: A237-44(Oct. 4, 1965).

An experiment to measure the effective mass m_+^* of positrons in metals is discussed. We take advantage of the fact that there is a sharp break in the angular-correlation curve of the annihilation γ rays at the Fermi momentum. The experiment then consists in a study of the temperature dependence of the angular-correlation curve, to find how this break disappears with rise of temperature. (auth)

43129 STUDY OF THE PERTURBATION SERIES FOR THE GROUND STATE OF A MANY-FERMION SYSTEM. [PART] III. Baker, George A. Jr. (Los Alamos Scientific Lab., N. Mex.; Univ. of London). Phys. Rev., 140: B9-19 (Oct. 11, 1965). (LA-DC-7157).

The many-fermion energy expansion through the sixth order in the Fermi momentum is derived. The expansion is compared with actual energies previously computed for the square-well potential. An approximation scheme, valid over a significant range of conditions is introduced, which includes, infinite nuclear matter. It is shown that saturation is almost certainly a singular point of the many-fermion energy curve. (auth)

43130 REGENERATION OF K_1^0 MESONS AND THE K_1^0-K_2^0 MASS DIFFERENCE. Christenson, J. H.; Cronin, J. W.; Fitch, V. L.; Turlay, R. (Princeton Univ., N. J.). Phys. Rev., 140: B74-84(Oct. 11, 1965).

The regeneration of K_1^0 mesons using a beam of K_2^0 mesons produced at the Brookhaven AGS. The K_1^0 mesons were detected with a pair of magnet–spark-chamber spectrometers that momentum-analyzed the two decay pions. A test of the coherence of the transmission regeneration is made by comparing the yields from half- and full-density copper regenerators. The K_1^0-K_2^0 mass difference was measured with a regenerator consisting of two pieces of copper separated by a variable air gap. This method is independent of all nuclear scattering parameters and yields a mass difference of 0.50 ± 0.10 in units of $\hbar/\tau_1$ (where τ_1 is the K_1^0 mean life). Data taken with single copper regenerators of various thicknesses yield mass differences consistent with this measurement. Mass differences larger than 1.0 are strongly rejected by the data. The forward regeneration cross sections for C, Cu, Fe, and W were measured and found to agree with optical-model calculations. Regeneration in liquid hydrogen was also investigated and the results compared with theoretical predictions. (auth)

43131 NON-REGGEIZATION OF THE VECTOR MESON. Chester, Arthur N. (California Inst. of Tech., Pasadena). Phys. Rev., 140: B85-9(Oct. 11, 1965). (CALT-68-39).

Nucleon-antinucleon scattering is treated in a field theory of interacting vector mesons and spin-$\frac{1}{2}$ or spin-0 nucleons. Some cancellations in the asymptotic sixth-order amplitudes are demonstrated and disagreements in earlier papers are resolved. It is found that the vector-meson singularity in the partial-wave amplitudes is unaffected and that therefore the vector meson does not lie on a Regge trajectory to this order. (auth)

43132 INELASTIC RESONANCES AND CASTILLEJO-DALITZ-DYSON SINGULARITIES. Hartle, James B.; Jones, C. Edward (Princeton Univ., N. J.). Phys. Rev. 140: B90-4(Oct. 11, 1965).

By considering many coupled two-body-channel scattering amplitudes that possess a unique continuation in the angular-momentum variable it is shown (1) that several methods of obtaining the single-channel N/D solution for the elastic amplitude with an inelasticity factor agree with the corresponding many-channel matrix N/D solution at high l; (2) that in order to preserve agreement when continuing to low angular momentum one must generally introduce Castillejo-Dalitz-Dyson (CDD) cuts or poles into the single-channel D function; (3) and that the integral equations for N/D may be continued in l, automatically yielding the CDD cuts mentioned above. Finally, a distinction between elastic and inelastic resonance poles is introduced based on continuation in l and it is shown that the latter will not appear in calculations that fail to include the requisite CDD singularities. (auth)

43133 BARYON-ANTIBARYON SCATTERING IN THE M(12) SYMMETRY SCHEME. Lo, Shui-yin (Univ. of Chicago). Phys. Rev., 140: B95-6(Oct. 11, 1965). (COO-264-256).

The M(12) symmetry scheme was applied to baryon-antibaryon scattering processes. There are in all four independent amplitudes. It is found that (i) all inelastic-scattering amplitudes vanish at threshold, (ii) in certain processes such as $\bar{p} + n \to \bar{\Xi}^0 + \Xi^-$ the outgoing baryons are completely unpolarized, (iii) sum rules for the amplitudes result. The nonrelativistic limit is also discussed. (auth)

43134 USE OF ANGULAR-MOMENTUM TENSORS. Zemach, Charles (Univ. of California, Berkeley). Phys. Rev., 140: B97-108(Oct. 11, 1965).

The properties of tensor representations are developed for application to angular-momentum problems in elementary-particle reactions. (auth)

43135 DETERMINATION OF THE SPINS AND PARITIES OF RESONANCES. Zemach, Charles (Univ. of California, Berkeley). Phys. Rev., 140: B109-24(Oct. 11, 1965).

The properties of angular-momentum tensors are used to develop tests for the spins and parities of resonances. Fermion resonances decaying into particles of spin zero and spin one-half or spin zero and spin three-halves and boson resonances decaying into particles of spin zero and spin one are considered in some detail. Attention is given to angular correlations between production and decay configurations, both generally and in special cases such as forward production, low-energy production, and peripheral collisions. A moment analysis of the decay distributions is developed. (auth)

43136 CP VIOLATION IN NONLEPTONIC K^0 DECAYS. Tanaka, K. (Ohio State Univ., Columbus). Phys. Rev., 140: B124-6(Oct. 11, 1965). (COO–1261-9).

The nonleptonic K^0 decays are examined on the basis of the CPT theorem and unitary symmetry without the requirement of CP invariance. It is shown that the present model (based on the CPT theorem and unitary symmetry) is consistent with the various experimental branching ratios of $K \to 2\pi$ modes, if CP invariance is almost maximally violated. Further, the decays $K_1^0 \to 3\pi^0$ and $K_2^0 \to 3\pi^0$ are forbidden by unitary symmetry in the framework of the boson pole model, even if CP invariance is violated. (auth)

43137 MECHANISMS FOR THE $T = \frac{1}{2}$ AND $T = \frac{3}{2}$ RECURRENCES. Auvil, P. R.; Brehm, J. J. (Northwestern Univ., Evanston, Ill.). Phys. Rev., 140: B135-42(Oct. 11, 1965).

The conjecture that inelastic states containing an f meson should provide a natural-recurrence mechanism is investigated. Coupled $N\pi$ and $N_R f$ channels are treated where, in seeking a recurrence, N_R denotes the previous recurrence. It is established that the attraction is always maximal for angular momentum and parity corresponding to the recurrence state. In particular, the $\frac{1}{2}^+$ ($T = \frac{3}{2}$) and $\frac{3}{2}^+$ ($T = \frac{1}{2}$) states are considered and it is found that the attraction is strong enough to produce resonances. Coupled $N_R\pi$ and $N_R f$ states are considered and a search was made for these resonances in $N_R\pi$ scattering. The resonance positions determined by taking this point of view are vastly improved. In particular, if a static version of SU(6) symmetry is considered a $\frac{7}{2}^+$($T = \frac{3}{2}$) resonant state is obtained in good agreement with observation. (auth)

43138 DYNAMICAL BASIS OF THE SUM RULE $2\,\Xi^- = \Lambda^0 + \sqrt{3}\Sigma^0$. [PART] II. Lee, Benjamin W. (Inst. for Advanced Study, Princeton, N. J.; Univ. of Pennsylvania, Philadelphia). Phys. Rev. 140: B152-3(Oct. 11, 1965).

The assumptions that (1) the weak processes $B \to B'$, $M \to M'$ ($\Delta S = \pm 1$) are mediated by an interaction that transforms like λ_6, (2) the nonleptonic decay amplitudes of hyperons are dominated by pole terms, and (3) the mass-splitting pattern of the baryon octet can be approximated by $m = m_0 + (\Delta m)\,Y$ imply that the effective Lagrangian describing the parity-conserving hyperon decays transforms like λ_7 under SU(3). The sum rule $2P(\Xi^-) = P(\Lambda^0) + \sqrt{3}P(\Sigma_0^+)$ follows immediately from this observation. (auth)

43139 INTERMULTIPLET MASS FORMULA FOR MESONS. Belinfante, J. G. (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev., 140: B154(Oct. 11, 1965).

An SU(6) intermultiplet mass formula for mesons is presented which relates the average masses of the pseudoscalar and vector octets and the X^0 singlet. The meson mass splittings are also related to the baryon mass splittings on the basis of a bootstrap model of the baryon supermultiplet. (auth)

43140 INTERNAL-SYMMETRY GROUPS AND CURVED SPACE-TIME. Acharya, R.; Narayanaswamy, P. (Tata Inst. of Fundamental Research, Bombay). Phys. Rev., 140: B155-7(Oct. 11, 1965).

Some theorems are proved which exhibit the impossibility of constructing nontrivial products of the 3 + 2 de Sitter group with internal-symmetry groups (under physically reasonable assumptions). It is shown that either mass degeneracy, $[E_\alpha, P_\mu] = 0$, or simultaneous measurement of internal quantum numbers and momentum, $[H_1, P_\mu] = 0$, is alone sufficient to imply a direct product relationship. In this sense, the combination of internal symmetry and de

Sitter symmetry in a closed system is even less reasonable physically than a combination of internal symmetry and Lorentz invariance (or Galilean invariance). (auth)

43141 FIELD THEORY OF MATTER. [PART] IV. Schwinger, Julian (Harvard Univ., Cambridge, Mass.). Phys. Rev., 140: B158-63(Oct. 11, 1965).

The relativistic dynamics of 0^- and 1^- mesons in the idealization of U_3 symmetry is derived from the hypothesis that a compact group of transformations on fundamental fields induces a predominantly local and linear transformation of the phenomenological fields that are associated with particles. The physical picture of phenomenological fields as highly localized functions of fundamental fields implies that the interaction term of the phenomenological Lagrange function can have symmetry properties, expressed by invariance under the compact transformation group, that have no significance for the remainder of the Lagrange function, which describes the propagation of the physical excitations. It is verified that the meson interaction term derived by considering fundamental fermion fields is invariant under the parity-conserving group $U_6 \times U_6$. The implied connection between the $\rho\pi\pi$ and $\omega\rho\pi$ coupling constants is well satisfied. There is a brief discussion of the dynamics of fermion-particle triplets, from which it is shown that the invariance of the similarly derived interaction term implies the mass degeneracy of the singlet and octuplet of 1^- mesons, without relation to 0^- masses. The triplets are also used to illustrate the derivation of gauge- and relativistically invariant electromagnetic properties. The mass degeneracy of the nine 1^- mesons, and of nine 2^+ mesons, can be inferred from the commutation properties of bilinear combinations of the fundamental field. (auth)

43142 MASS FORMULAS AND BARYON STATES IN SU(6) SYMMETRY. Gyuk, Imre P. (Syracuse Univ., N. Y.); Tuan, S. F. Phys. Rev., 140: B164-74(Oct. 11, 1965).

The mass formulas of baryon states in SU(6) symmetry are examined in detail to exhibit the deep structural similarity between the 56- and 70-dimensional representations and the existence of a hierarchy of mass-breaking terms in these formulas which suggest strongly the dominance of the contribution due to the 35 representation. Implications of this form resemblance for the existence of a possible higher symmetry, in particular relativistic generalizations of SU(6), are briefly discussed. Finally a critical analysis is made of the basis for a $(70)^-$ representation of baryon states. (auth)

43143 INELASTIC EFFECTS IN ONE-CHANNEL N/D CALCULATIONS. Finkelstein, Jerome (Univ. of California, Berkeley). Phys. Rev., 140: B175-7(Oct. 11, 1965). (UCRL-16091).

The possibility of including inelastic effects within a one-channel N/D calculation is discussed, and it is seen that the one-channel calculation agrees with the Bjorken matrix calculation whenever the elastic amplitude has no zero on the physical sheet. An example indicates that this may be the case for $\pi\pi$ scattering in the ρ channel. (auth)

43144 THEORY OF π (K) + N $\rightarrow$ π (K) + Δ REACTIONS. Hara, Yasuo (Univ. of Chicago). Phys. Rev., 140: B178-82(Oct. 11, 1965). (COO-264-255).

The production of the Δ ($N^*_{3,3}$) and Y_1^* (1385) P_{3_3} isobars by π, K, and $\bar{K}$ mesons is discussed. We assume the Chew-Low static model for Δ and Y_1^*, but do not assume anything about the exchange mechanism such as the ρ-meson exchange. It is shown that for fixed small momentum transfer and for fixed energy the decay distributions of Δ and Y_1^* and the distribution of the Treiman-Yang angle are equal to those predicted by the ρ (or K^*) meson exchange model with $M1 \rightarrow P_{3_3}$ transition. This result is valid both for any elementary meson ($J > 0$) exchange models and for the Regge-pole models. In the same approximation we obtain relations such as $d\sigma(\pi^+p \rightarrow \pi^0\Delta^{++})/dt = \frac{3}{2}\, d\sigma(\pi^+n \rightarrow \pi^0p, \text{spin flip})/dt$. Making use of the relation, we can predict that the spin-flip part of the πN charge-exchange scattering is very large. The Regge-pole model is applied to these processes. In the ρ (or K^*) Regge-pole exchange model, the angular distributions at a large momentum transfer $t \approx -1\ (\text{Bev})^2$ are found to be equal to those predicted by the ρ (or K^*) meson exchange model with $L2 \rightarrow P_{3_3}$ transition. (auth)

43145 DENSITY-MATRIX ANALYSIS FOR SPIN DETERMINATION. Ademollo, M.; Gatto, R.; Preparata, G. (Universita, Florence; Istituto Nazionale di Fisica Nuclear, Florence). Phys. Rev., 140: B192-8(Oct. 11, 1965).

The general properties of the density matrix of an unstable particle produced in a two-body collision are analyzed with a view toward deriving useful tests for the spin of the particle. Spin tests are obtained for production on polarized and on unpolarized targets, and special situations which do not allow for a complete determination of the density matrix are examined. Production of the unstable particle from a spinless boson incident on a spin-$\frac{1}{2}$ fermion is discussed in particular, and a special decomposition of the density matrix for that case appears to be quite useful for formulating tests of spin. Inequalities that must be satisfied from the elements of the density matrix are expressed in terms of directly measurable quantities and shown to provide general sets of spin tests. (auth)

43146 RELATION BETWEEN POLES IN PROPAGATORS AND THE EXISTENCE OF PARTICLES. Perrin, Robert (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 140: B199-200(Oct. 11, 1965). (MIT-2098-147).

It is shown that in a relativistic field theory the existence of a pole in a propagator at an unphysical value of p^2 does not imply the existence of a discrete state in the theory having this value of p^2 as an eigenvalue. (auth)

43147 PREDICTIONS FOR $\pi^- + p \rightarrow \eta^0 + n$ FROM REGGE POLES AND SU_3. Phillips, Roger J. N.; Rarita, William (Univ. of California, Berkeley). Phys. Rev., 140: B200-1(Oct. 11, 1965). (UCRL-16097).

It is assumed that the charge-exchange process $\pi^- + p \rightarrow \eta^0 + n$ is dominated by the R Regge pole. A prediction for the cross section is then made, by taking Regge-pole parameters from a previous analysis of πN and KN scattering, and by invoking SU_3 symmetry. (auth)

43148 Ξ^{*0}-Ξ^{*-} MASS DIFFERENCE. Kumar, Aditya (Univ. of Delhi). Phys. Rev., 140: B202-4(Oct. 11, 1965).

The Ξ^{*0}-Ξ^{*-} electromagnetic mass difference is calculated using a method suggested by Dashen and Frautschi. It is assumed that Ξ^* is a bound state of $\bar{K}$ and Λ. The contributions to the mass difference arising from kinematics, photon exchange, mass difference of the crossed nucleon, and the vertex corrections to the ΛNK coupling constant are included. The calculated mass difference is in agreement with the experimental value of Pjerrou et al. (auth)

43149 APPLICATION OF THE BETHE-SALPETER EQUATION TO THE STATIC BOOTSTRAP MODEL. Lin, K. Y.; Cutkosky, R. E. (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev., 140: B205-11(Oct. 11, 1965).

The well-known static N-N* bootstrap model is reinvestigated by using the Bethe-Salpeter equations and an approximation which is similar to the effective-range approximation. The mass difference between the N and N* was found to be 0.3 in units of the average energy of the meson cloud. If SU(3) symmetry is assumed, then the mass difference is smaller (in this unit), and the F-D mixing angle is close to 38°. (auth)

43150 GENERALIZED FADDEEV INTEGRAL EQUATIONS FOR MULTIPARTICLE SCATTERING AMPLITUDES. Rosenberg, Leonard (New York Univ., New York). Phys. Rev., 140: B217-26(Oct. 11, 1965).

The Faddeev integral equations for nonrelativistic three-body scattering amplitudes are generalized to apply to the multiparticle-scattering problem. The equations obtained are similar in structure to the N-body formulation of Weinberg and have the same desirable feature, namely, that δ-function singularities in the kernel due to discon-

nected processes have been removed, so that Fredholm theory may be expected to apply. A possible advantage of the present (Faddeev-type) approach to the N-body problem is that the potentials do not appear explicitly; they have been formally eliminated in favor of the two-body scattering amplitudes. In addition to the integral equations for the scattering amplitudes, in all channels, we obtain integral equations for the wave function and for the effective (or optical) potential. A minimum principle for the effective potential obtained previously for N = 3 is generalized to arbitrary N. To illustrate the possible utility of these equations for a wider class of problems where potentials are not defined, we have shown that the Lee model in the three-particle sector can be reformulated in terms of the Faddeev equations, without introducing field operators. (auth)

43151 EVIDENCE FOR PARITY-SU(3) MIXING IN THE MESON NONETS. Marshak, R. E.; Okubo, S.; Wojtaszek, J. H. (Univ. of Richester, N. Y.). (Phys. Rev. Letters, 15: 463-7(Sept. 6, 1965).

Recent experimental evidence for a $J = 0^+$ meson at about 700 Mev together with increasing evidence for the existence of positive-parity mesons of higher spin, has led to the sharpening up of predictions of the $\overline{W}(3)$ and $S\overline{W}(3)$ theories for mesons. The essential improvement over the previous calculation consists in taking account of the VS symmetry-breaking term to all orders. Since the VS interaction does not destroy the purity of the irreducible SU(3) representations, account may be taken of its higher order effects by simply allowing for arbitrary spacings between S_1, P_8, S_8, and P_1. If the weaker MS interaction is then switched on to first order, predictions with comparable accuracy to those which follow from the usual SU(3) theory are obtained. Following this method all 16 cases of a reference cited were recalculated. While further experimental evidence is needed, it is believed that the results for the J = 1 and J = 2 meson nonets provide the first serious evidence for a higher symmetry group which mixes parity and SU(3). (J.F.P.)

43152 DETERMINATION OF THE SPINS AND PARITIES OF $N_\delta^*(1688)$ AND $N_\delta^*(1920)$. Duke, P. J. (Rutherford High Energy Lab., Chilton, Eng.); Jones, D. P.; Kemp, M. A. R.; Murphy, P. G.; Prentice, J. D.; Thresher, J. J.; Atkinson, H. H.; Cox, C. R.; Heard, K. S. Phys. Rev. Letters, 15: 468-72(Sept. 6, 1965).

A preliminary report is given on the results of two counter experiments recently completed. Differential cross sections for π^+p and π^-p elastic scattering were measured at a number of momenta in the region of the isobar $N_\delta^*(1688)$ and $N_\delta^*(1920)$, which occur at meson(π) laboratory momenta of 1030 and 1505 Mev/c, respectively. Polarization effects were also measured in the same region using a polarized proton target of a type recently described. The expansion coefficients were obtained for the scattering of mesons(π) from the differential cross sections by the method of least-squares fitting and are plotted as functions of beam momentum. The spins and parities of the two resonance baryons are determined. (J.F.P.)

43153 ON THE CALCULATION OF REGGE TRAJECTORIES IN NONRELATIVISTIC POTENTIAL SCATTERING. Mueller, H. J. W. (Institut fuer Theoretische Physik, Munich). Physica, 31: 688-92(May 1965).

It is shown that perturbation theory yields easily asymptotic expansions for Regge trajectories in potential theory. Expansions previously obtained follow as special cases of the more general result. (auth)

43154 THE SYMMETRY BREAKING INTERACTION. Ne'eman, Yuval (California Inst. of Tech., Pasadena). Physics, 1: 203-7(Jan.-Feb. 1965).

The bootstrap idea is explored in terms of a non-linear equation projecting all hadron states out of one master field. The symmetries are assumed to derive from the non-strong interactions, the bootstrap's role being reduced to their regeneration as strong-interactions symmetries. The interaction responsible for the breaking of SU(3) is reviewed and its non-bootstrap features are emphasized. Finally, some remarks are included with respect to an R(8) extension of SU(3)/Z(3) capable of yielding $\Delta S = -\Delta Q$ weak currents and the anomalous $K_2^0 \to 2\pi$ decay. (auth)

43155 CLASSICAL EXAMPLES OF SPACE INVERSION AND TIME REVERSAL. Schiff, L. I. (Stanford Univ., Calif.). Physics, 1: 209-13(Jan.-Feb. 1965).

The motions of four different classical systems under space inversion (P) and time reversal (T) are discussed. It is imagined that each system is photographed with a motion picture camera, and that the film is developed and positively printed. The film may then be inverted front for back and run through the projector in normal time sequence (P), or run through the projector in the correct orientation but backward in time (T). If the projected image represents a possible motion of the system, it is P or T invariant, as the case may be. Classical models of a moving charge, a precessing magnetic dipole, a moving magnetic monopole, and a precessing electric dipole, are considered. As might be expected, the first two systems turn out to be separately P and T invariant, and the last two are neither P nor T invariant. A brief comment is made on charge conjugation (C) invariance and the classical validity of CPT invariance. (auth)

43156 RENORMALIZATION EFFECTS FOR PARTIALLY CONSERVED CURRENTS. Fubini, S. (Universita, Turin and CERN, Geneva); Furlan, G. Physics, 1: 229-47(Jan.-Feb. 1965).

It is shown how to obtain, through the use of suitable commutation relations, sum rules for the renormalization ratios between bare and dressed coupling constants. The method is completely general and it can be applied to any broken symmetry. As an illustration the cases of the weak vector current, both strangeness-conserving and strangeness-changing were considered. (auth)

43157 POSITRON ANNIHILATION IN METALS. Kanazawa, Hideo; Ohtsuki, Yoshihiko; Yanagawa, Sadaaki (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 33: 1010-21 (June 1965).

A correlation function for a positron-electron pair within a metal is obtained by solving an extended Bethe-Goldstone equation which includes the short range positron-electron hole interaction besides the short range positron-electron interaction. The computed lifetimes of positrons are longer than those calculated by Kahana. The effects of the long range Coulomb interaction on the annihilation rates are investigated. It is pointed out that the two-photon annihilation process accompanied by a plasmon emission in metals with low electron densities may not be neglected. (auth)

43158 ONE PION PRODUCTION BY NEUTRINO REACTION IN $\rho\pi$-CURRENT MODEL. Kawakami, Akira (Tokyo Univ.); Fukawa, Mineo. Progr. Theoret. Phys. (Kyoto), 33: 1079-88(June 1965).

One pion production by the high energy neutrino-nucleon collision process is discussed. The cross section of $\nu + N \to N + \mu + \pi$ is estimated by the introduction of the $\rho \to \pi + l + \nu$ process which is determined by the axial-vector current of neutron β decay. The coupling constant $g_{\rho\pi l}$ of $\rho \to \pi + l + \nu$ is estimated from the contribution of this process to the axial-vector current of nucleon β decay as follows: $g_{\rho\pi l} = 3.0(\Delta\lambda/f_{\rho N})G_A$, where $\Delta\lambda$ is fraction of $\rho\pi$-current contribution to the axial-vector current of nucleon β decay. If $\Delta\lambda = 0.25$, then the cross section of our process is smaller than that of the experimental value by about an order, but if $\Delta\lambda = 0.78$, the cross section is comparable to the experimental value $\sim 10^{-38}$ cm^2 which explains the discrepancies between the previous theoretical value of Fukawa and the experimental one. (auth)

43159 V-STRAP MODEL FOR PS-PS SCATTERING AND THE STABILITIES OF VARIOUS SOLUTIONS. Kanazawa, Akira; Tokuda, Naoki (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto), 33: 1089-97(June 1965).

The V($J^P = 1^-$)-strap model of the scattering between the mass-degenerated pseudoscalar (ps) mesons is examined in connection with the possible dynamical origin for the symmetry of strong interaction. If only the charge independence and the conservation of strangeness are assumed there are six isomultiplets (and their antiparticles) of vector mesons composed of various pair of ps mesons π, K, and η. It is known that there are many sets (schemes), besides the octet, of V mesons out of the six mentioned above, which equally satisfy the V-strap self-consistent equations. Thus further conditions are needed in addition to the requirement of the self-consistency to pick out a physically acceptable solution among otherwise allowed solutions. The additional condition considered is the stability of the solutions for the small variation of the input mass, the mass of exchanging V mesons. It is shown that the octet (ρ, M, ω) and the three single particle schemes (ρ), (M), (ρ') are stable, but all other irreducible schemes are unstable under the stability condition mentioned above. (auth)

43160 LARGE t LIMIT OF COMPTON SCATTERING OF A SCALAR PHOTON BY A SCALAR NUCLEON IN PERTURBATION EXPANSION. Otokozawa, Jun; Suura, Hiroshi (Nihon Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 33: 1098-1106(June 1965).

Ladder diagrams for Compton scattering of a massless scalar photon by a scalar nucleon are evaluated in the large t limit. The leading term in the 2n-th order is found to be $(\ln t)^{2n-2}/t$, compared to $(\ln t)^{n-1}/t$ for the case of scattering of two scalar particles of finite masses. In terms of partial waves, the 2n-th order diagram gives a leading singularity $1/(l+1)^{2n-1}$ at $l = -1$, compared to $1/(l+1)^n$ for the finite mass case. Regge poles generated by summing ladder diagrams and the corresponding large t behavior are discussed. (auth)

43161 RELATIVISTIC THREE FIELD MODEL (12 DIMENSIONAL PSEUDUNITARY GROUP) AND WEAK CURRENT. Miyamoto, Yoneji (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 33: 1131-2(June 1965).

The relativistic generalization of the SU(6) theory to the PSU(12) group is considered. The weak currents of the three kinds of $J = \frac{1}{2}$ octets, which are the subgroups of the (364) irreducible representations for fermions were investigated; an expression was obtained which is in contradiction with Cabibbo's current. It is suggested that the relativistic model in which the mass of the fundamental fields is taken into account must be considered. (L.B.S.)

43162 DETERMINATION OF THE $\gamma\pi\rho$ COUPLING CONSTANT. Kawaguchi, Masaaki; Yokomi, Hiroyuki (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 33: 1132-3(June 1965).

A method is pointed out for obtaining direct information on the $\gamma\pi\rho$ effective coupling constant from the results of a previous experiment on positive and negative pion photoproduction with linearly polarized gamma rays. (L.B.S.)

43163 ON THE DECAY OF KAONS. Nakamura, Seitaro (Nihon Univ., Tokyo); Ishii, Katsuhiko; Itami, Kunio; Sato, Shigeo. Progr. Theoret. Phys. (Kyoto), 33: 1133-5 (June 1965).

The observation of the forbidden decay mode, $K_S^0 \to \pi^+\pi^-$, led to the hypothesis on the existence of a new kaon K_Y^0 and a new interaction with meso-strong coupling. (L.B.S.)

43164 RETARDATION EFFECT ON HIGH-ENERGY PROTON-PROTON SCATTERING. Kitakado, Shinsaku (Nagoya Univ., Japan). Progr. Theoret. Phys. (Kyoto), 33: 1139-41(June 1965).

It is suggested that the retardation effect in high energy p-p scattering causes shrinkage at small scattering angles, on the basis of an investigation in which the Klein-Gordon equation is assumed to describe the scattering in the center of mass system. (L.B.S.)

43165 NEUTRINO UNIFIED MODEL FOR ELEMENTARY PARTICLES. Katayama, Yasuhisa (Kyoto Univ.); Taketani, Mituo ,Progr. Theoret. Phys. (Kyoto), 33: 1141-3(June 1965).

A model of elementary particles is presented, which is based on the unified viewpoint that all existing particles are originated from the neutrino, and their variety is assured by the two kinds of charge substance. (L.B.S.)

43166 AN APPROACH TO THE SYMMETRY OF HADRONS ON THE BASIS OF THE LIE GROUP Sp(3). [PART] I. Shima, Kazuhisa; Tanabe, Kosai (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 34: 20-45(July 1965).

On the basis of the unitary symplectic group Sp(3) of rank three, a symmetry scheme of hadrons is proposed in such a way that the product of Gell-Mann's octuplet scheme is succeeded to and some unsatisfactory aspects of his are improved. The 14-dimensional respresentation of Sp(3) is employed for the baryon and the ps-meson family, and the 21-dimensional one (adjoint representation) for the vector meson family. The octuple baryon multiplet and the octuple ps-meson one in Gell-Mann's scheme are embedded into the supermultiplets forming a giant multiplet in the 14-dimensional representation, in either case, and the octuple v-meson multiplet together with the singlet one is incorporated to the constituents of a giant multiplet for the 21-dimensional representation. The problem of the so-called φ-ω mixing is then discussed from the standpoint of this scheme. As a consequence of the employment of the Lie group of rank three, a third additive quantum number called superstrangeness is introduced, which plays an important role in characterizing the postulated hadrons. As for the usual hadrons only, the quantum number imposes no further selection rule on the process in the strong interaction. On the other hand, it works so as to make the superstrange hadrons appear pair-wise in the creation and scattering process and materializes the gross structure of the baryon or the meson family regarded as a giant multiplet. The mass relations among the hadrons in this scheme contain Gell-Mann-Okubo's and allow the superstrange hadrons to be much heavier than the usual ones. The electromagnetic mass differences of hadrons and the magnetic moments of baryons are investigated in comparison with Coleman-Glashow's results. (auth)

43167 A NOTE ON THE DECOMPOSITION STRUCTURE OF THE DIRECT PRODUCT OF IRREDUCIBLE REPRESENTATIONS OF SU(3) BY TENSOR METHOD. Mukunda, N.; Pandit, L. K. (Univ. of Rochester, N. Y.). Progr. Theoret. Phys. (Kyoto), 34: 46-55(July 1965). (UR-875-71).

Tensor methods are employed to determine which unitary irreducible representations (UIR's) (α,β) occur in the reduction of the direct product $(\lambda,\mu) \otimes (\lambda',\mu')$ of two arbitrary UIR's of SU(3). For λ', μ' large enough $(\lambda',\mu' \geq \lambda + \mu)$, it is shown that all the representations (α,β) are given by the following unique correspondence: For each pair of I_z, Y values (i.e., to each "weight") occurring in the representation (λ,μ) there is a representation (α,β) with $\alpha = \lambda' + I_z + (\frac{1}{2})Y$, $\beta = \mu' + I_z - (\frac{1}{2})Y$, where the multiplicity of occurrence of (α,β) is the same as the multiplicity of the weight I_z, Y in the representation (λ,μ). (auth)

43168 SYMMETRY BREAKING INTERACTIONS IN SU(3)/Z(3) SYMMETRY. Iwao, Syurei (Universitaet, Bern). Progr. Theoret. Phys. (Kyoto), 34: 56-63(July 1965).

Symmetry breaking due to the medium-strong interaction is taken into account for the electromagnetic and weak interactions in the octet version of the unitary symmetry model (SU(3)/Z(3) group). The result is applied to the electromagnetic form factors and the weak leptonic decay of baryons. A postulate (which is expected to hold about 98% accuracy) derived from the detailed study of the electromagnetic mass of the octet baryons will serve to gain more information than by the mere study of the symmetry breaking solution. Among them, one relation obtained for the magnetic moments of the octet baryons will be of par-

ticular interest. Several relations derived for the effective coupling constants of the baryon leptonic decays will become important once the experimental accuracy of the branching ratio of these decays increases. (auth)

43169 MASS SPLITTING OF MESONS AND BARYONS AND COMPOSITE MODEL. **Ishida, Shin (Nihon Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 34: 64-73(July 1965).**

Mass splitting of mesons and baryons, both interunitary multiplets and interisomultiplets, is discussed by a simple method under the assumption that the origin of the breakdown of SU(3) symmetry is merely due to the existence of small mass differences among the fundamental triplet, of which all particles are composed. Beyond the well-known formulas which are derived under the general assumption on the transformation property of the symmetry breaking Hamiltonian in unitary space, many new mass formulas are derived, which agree with experimental results fairly well. (auth)

43170 COMPOSITE-PARTICLE SCATTERING IN NON-RELATIVISTIC OFF-SHELL THEORY. **Mishima, Nobuhiko (Tokyo Metropolitan Univ.). Progr. Theoret. Phys. (Kyoto), 34: 74-91(July 1965).**

On the basis of the Faddeev equations for three-body scattering amplitudes, the scattering formalism involving composite particles is investigated in comparison with the S-matrix formalism. First, the amplitude is defined by the residue at the poles corresponding to the composite particles in Faddeev's three-body scattering matrix and then the equation for the off-shell amplitude, which was firstly given by Lovelace, is reduced from the Faddeev equations by the simpler and unambiguous way. Unlike the case of the on-shell S-matrix theory, the off-shell potential does not give rise to any anomalous threshold, but includes the upper anomaly coming from the three-body unitary cut. In order to obtain the solution satisfying the two-body unitarity relations, an off-shell N/D method is introduced. The off-shell formalism obtained includes the three-body cut more self-consistently and does not require any ambiguous procedure for the treatment of the singularities due to the unstable particles, while the expediential procedure is more or less needed in the S-matrix formalism. (auth)

43171 GREEN'S FUNCTION APPROACH AND ITS EQUIVALENCE WITH THE ORDINARY N/D METHOD. **Ida, Masakuni (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 34: 92-115(July 1965).**

Green's function approach to the scattering of two particles in a channel with a one-particle intermediate state is investigated in detail under the elastic approximation, with due attention to propagator zeros. In relation to the asymptotic behavior of the spectral function in the Lehmann representation of the propagator, particles are classified into four types; super-elementary, elementary, intermediate and composite. It is shown that the present approach is equivalent to the ordinary N/D method. Criticism to some earlier works is also given. (auth)

43172 A NOTE ON THE NON-CONSERVATION OF PARITY IN WEAK INTERACTION. **Bandyopadhyay, Pratul (Indian Statistical Inst., Calcutta). Progr. Theoret. Phys. (Kyoto), 34: 116-23(July 1965).**

From the theoretical viewpoint that there are two kinds of particles in nature having structural orientations mutually opposite to each other, a generalized symmetry rule of weak interactions is introduced. On the basis of the assumption that fermions (antifermions) have a well defined structural orientation, though this is not the case for bosons (antibosons), it is shown that the conservation of parity in $\Sigma^{\pm} \rightarrow n + \pi^{\pm}$ decays can be explained in the general framework of weak interactions and is related to the fact that Σ^{-} is not the antiparticle of Σ^{+}. Finally, some remarks about the composite nature of mesons and baryons, the conservation of lepton and baryon number and the non-existence of any rule like the conservation of meson number are made in view of the above assumption. (auth)

43173 SPACE-TIME MODEL OF ELEMENTARY PARTICLES AND UNITARY SYMMETRY. [PART] I. GENERAL FOUNDATION AND SYMMETRY. **Takabayasi, Takehiko (Nagoya Univ., Japan). Progr. Theoret. Phys. (Kyoto), 34: 124-54(July 1965).**

The general framework is given of a unified theory of elementary particles based on the hypothesis that a particle should be association of four space-time points. With the separation of the center-of-mass degree of freedom the relative motion of the system is described by a set of three normal axes. The equivalence of the normal axes implies the O(3) symmetry which is independent of the Lorentz transformation. The wave equation contains an invariant potential representing a strong direct non-local interaction working inside the particle to ensure that the motion of normal coordinates is of oscillator-type maintaining the four-point association within a small space-time region (with a characteristic length). This entails the wider U(3) symmetry that includes the above O(3) subgroup as well as the internal self-reciprocity. In this model the unitary spins including isospin and hypercharge originate from excitations of oscillatory motions of normal axes with respect to the figure space, while the spin is due to the rotational part of the relative motion with respect to the inertial frame. If in the system one of the four points becomes inequivalent with the other three, it implies the usual symmetry-breaking of U(3). The meaning of the required triality condition is considered. The whole treatment is made in conformity with relativistic covariance, but on the level of one-particle theory. (auth)

43174 REPULSIVE CORE OF EFFECTIVE α-α POTENTIAL. **Tamagaki, Ryozo; Tanaka, Hajime (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto), 34: 191-2(July 1965).**

An investigation was made of the origin of the repulsive core, the angular momentum dependence, and the energy independence of the effective α-α potential, based on solutions of the integro-differential equations for the α-α relative wave function. (L.B.S.)

43175 A KEY TO THE UNDERSTANDING OF THE UNIVERSE: THE STUDY OF NEUTRINOS. **Rev. Questions Sci., 136: 269-75(Apr. 1965). (In French).**

Neutrino sources, particularly improvements therein, are discussed, together with methods for focusing neutrinos and for removing other particles to obtain neutrinos only. Reports of the CERN conference of Jan. 20-22, 1965, are briefly considered with particular reference to detection methods and experiments for the detection of the W boson. (D.C.W.)

43176 OPTICAL ROTATORY POWER OF ELEMENTARY PARTICLES. **Ono, Ken-ichi (Tokyo Univ.). Sci. Papers Coll. Gen. Educ., Univ. Tokyo, 15: 43-4(June 1965).**

An interaction between elementary particles and the electromagnetic field previously proposed is discussed. The electric and magnetic moments of the particle arise only when accompanying the transitions with strangeness change. The polarizability and the optical rotatory power of the elementary particles can be calculated by a hamiltonian. It is concluded that based on empirical facts the possible existence of this interaction between elementary particles and the electromagnetic field cannot be rejected. It is, however, practically impossible to detect the rotatory power of elementary particles directly. Thus in order to use this interaction as a tool for the investigation of the internal structures of elementary particles, effects of this interaction larger than the rotation of the plane of polarization must be sought. (J.F.P.)

43177 THEORY OF THE WEAK INTERACTION. **Ono, Ken-ichi (Tokyo Univ.). Sci. Papers Coll. Gen. Educ., Univ. Tokyo, 15: 45-8(June 1965).**

A mathematical formulation is given for the previously suggested possibility of a parity non-conserving interaction of Pauli's type between baryons and the electromagnetic field resulting in the optical rotatory power of baryons. This is also extended to the treatment of weak interactions.

If particles change their sign, in the equation given, according to their strangeness, then some remarkable change in the feature of leptonic weak interactions is expected. The weak interactions between leptons and baryons are considered from this point of view. Although the previously proposed investigation of the internal structure of elementary particles by the optical rotatory power of elementary particles is too weak to be observed directly, the ν_e and ν_μ exchange their role, as is suggested, in the processes where there is a change of strangeness and thus may be of practical utility. An experimental phenomenon, which may be easy to detect, is suggested. (J.F.P.)

43178 ON THE PHASES OF ELASTIC n-d SCATTERING. Efimov, V. N.; Myachkova, S. A. Tr. Fiz. Inst., Akad. Nauk SSSR, 33: 199-202(1965). (In Russian)

In analyzing neutron scattering on deuterons at low energies, it is usually assumed that there is no spin-orbital interaction and that the total spin S and the orbital momentum l are good quantum numbers. Even though the experimental results of neutron polarization measurements during elastic scattering on deuterons are in agreement with the above assumption, it is still not possible to determine definitely the phases during scattering from an analysis of the angular distributions. The s-phases were fixed, and the p- and d-phases were determined from the best conditions of correspondence with the experimental data. Two phase sets were selected that agree with the experimental values of the differential cross sections. The quartet δ_0^3 and doublet δ_0^1 s-phases for these phase sets are as follows: (I) $\delta_0^3 = -1.027$ and $\delta_0^1 = -197$, and (II) $\delta_0^3 = -0.955$, and $\delta_0^1 = -0.810$. The ratio is between the quartet and doublet s-phases are substantially different for phase sets I and II. This behavior indicates that neutron depolarization will be much less if set II is in operation, and the polarization of recoil deuterons will be greater, if set I is in operation. Experimentally, it is more convenient to determine the polarization of scattered neutrons, since the energy losses for neutrons are much less than for recoil deuterons. ^{4}He and ^{24}Mg can be used as analyzers. The azimuthal asymmetry is ~0.1 for set I and ~0.2 for phase set II at an initial polarization of $P_0 = 0.4$ of neutrons from the ^{7}Li(p,n)^{7}Be reaction. About 10^3 neutrons/hr can be counted with the use of liquid helium and a current of 20 μamp. The asymmetry is smaller for deuterons: ~0.05 for set I and ~0.03 for phase set II. The count rate would be 10^2 counts/hr. Thus, additional information can be obtained on the phases of n-d scattering without the necessity of using a polarized deuterium target. (TTT)

43179 STUDY OF THE ANALYTICITY OF THE AMPLITUDE OF COMPOUND PARTICLE SCATTERING IN A FIELD. Chilashvili, G. A.; Shelest, V. P. (Inst. of Physics, Kiev). Ukr. Fiz. Zh., 10: 708-14(July 1965). (In Ukrainian).

A model of a compound particle moving with decay in an external field is considered. The analytical behavior of the partial scattering amplitudes is studied in a complex plane of total angular momentum. It is shown that the analytical structure of the scattering amplitudes is greatly complicated as compared with the two-particle problem, which indicates the poor effectiveness of the method of complex angular momenta for the study of multiparticle problems. (auth)

43180 ON PROPAGATORS AND VERTEX OPERATORS FOR PARTICLES WITH AN ARBITRARY SPIN. Volkov, D. V.; Chernyshov, Ya. K. (Inst. of Physics and Tech., Khar'kov). Ukr. Fiz. Zh., 10: 721-5(July 1965). (In Ukrainian).

It is shown that a complete set of independent vertex operators and Green functions with arbitrary spin may be constructed using derivatives with respect to momenta of the particles. (auth)

43181 REMARKS ON THE CP-PARITY. Okun', L. B. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 1: 938-9(May 1965). (In Russian).

The decay reaction $K_2^0 \to 2\pi$ can be explained by assuming that there is an x interaction which is a factor of 10^3 stronger than a weak interaction w, and about a factor of 10^5 weaker than a strong interaction s, for which $\Delta Y = 0$ and which is P-even, but C- and CP-odd. The decay $K_2^0 \to 2\pi$ would take place with the participation of all three types of interaction: $K_2^0 \xrightarrow{w} I_1 \xrightarrow{x} i_2 \xrightarrow{s} 2\pi$. Here I_1 and i_2 are intermediate virtual states. The existence of an x interaction should lead to a violation of C and CP invariance in the amplitudes of all processes with the participation of strongly-interacting particles on the order of 0.1%. (TTT)

43182 REMARKS ON THE CP ODD INTERACTIONS WITH $|\Delta S| > 1$. Okun', L. B. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 1: 1132-3 (June 1965). (In Russian).

A model is proposed for the $K_2^0 \to 2\pi$ decay, in which the decay is due to a CP-odd interaction with $|\Delta S| = 2$ with a fg^2 constant, where $g \sim 10^{-6}$ is a dimensionless constant of the usual weak interaction, and f is $\sim 10^{-2}$ to 10^{-3}. The $K_2^0 \to 2\pi$ reaction goes as follows: $K_2^0 \xrightarrow{fg} K_1^0 \xrightarrow{g} 2\pi$. The amplitude is fg^3/g^2 or ~fg (the mass difference between K_1^0 and K_2^0 is small). It is pointed out that an interaction with $\Delta S = \pm 2$ can have a constant on the order of fg, if $C = +1$, $P = -1$ and $CP = -1$. Also other processes with $\Delta S = \pm 2$ should have observable probabilities. The probability for the decay $\Xi \to n\pi^-$ should have $f^2 \sim 10^{-4}$ to 10^{-6} of the probability for the decay $\Xi \to \Lambda^0 \pi^-$. With $\Delta S = \pm 3$ the $K_2^0 \to 2\pi$ decay would go by way of a weak interaction with $CP = +1$ and $\Delta S = \pm 1$ as follows: K_2^0 ($|S| = 1$, $CP = -1$ $\xrightarrow{fg}$ i ($|S| = 2$, $CP = +1$) $\xrightarrow{g}$ K_1^0 ($|S| = 1$, $CP = +1$) $\xrightarrow{g}$ 2π. An interaction with $\Delta S = \pm 3$ should lead to decays of the type $\Omega^- \to n\pi^-$ or $\Omega^- \to \Lambda^0 \pi^-$ with probabilities $\sim 10^{-4}$ to 10^{-6} of the probability for the decay $\Omega^- \to \Xi \pi^-$. (TTT)

43183 MULTIPLICATION OF FLUXES AND $\Delta T = 3/2$ IMPURITY IN Λ HYPERON DECAYS. Kobzarev, I. Yu.; Okun', L. B. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz., 1: 1134-6 (June 1965). (In Russian).

The impurity contribution to the isotopic spin rule $\Delta T = \frac{1}{2}$ due to an initial weak interaction is estimated for the decay $\Lambda \to p\pi^-$. On multiplying the π flux (from the $\pi_{\mu 2}$) by the $A\bar{p}$ flux (from the decay $\Lambda \to pe\nu$), an admixture to the amplitude of the $\Lambda \to p\pi^-$ reaction is obtained that violates the $\Delta T = \frac{1}{2}$ rule. The calculated deviations from the $\Delta T = \frac{1}{2}$ rule are 30 to 40%, which are a factor of 4 greater than the experimental errors. It is necessary to improve the experimental accuracy in order to confirm the $\Delta T = \frac{1}{2}$ rule in $\Lambda \to p\pi^-$ decays. (TTT)

43184 REACTIONS GENERATING TWO MESONS AND UNITARY SYMMETRY. Belov, V. P. Yadern. Fiz., 1: 1137-8(June 1965). (In Russian).

The relations between amplitudes and cross sections of various processes can be obtained by unitary symmetry. Three-particle reactions are considered: $M_1 + N \to B + M_2 + M_3$. Here N is a nucleon; B is a baryon, and the M_1, M_2, and M_3 are pseudoscalar mesons. Within the framework of the octet version of unitary symmetry, the total number of independent amplitudes for reactions of the above type is equal to 32. The amplitudes of 68 of these reactions were calculated, and the results for the doubly-charged reactions, which are described by a minimum number of independent amplitudes, are presented in tabular form. With the use of the table it is possible to obtain relations between reaction amplitudes and inequalities for the corresponding cross sections. Five relations are presented, but the available experimental data are inadequate to confirm these relations. (TTT)

43185 SU6 COVARIANT S-MATRIX FORMALISM. Rothleitner, Josef; Stech, Berthold (Universitaet, Heidelberg). Z. Physik, 186: 399-409(1965).

Starting from the assumption that the SU(2) content of SU(6) refers to total angular momentum instead of intrinsic spin, a strictly Lorentz- and SU(6)-covariant S-matrix is constructed. The underlying symmetry is

closely connected to the inhomogenous SL (6,c) proposed by several authors. The approach leads to a unique description of how angular momentum has to be treated. It turns out that it is not sufficient to describe a p-wave by a "35" kineton except for very small particle momenta. (auth)

43186 A REMARK ON SU_4. Kabir, P.; Mueller, V. F. (CERN, Geneva). Z. Physik, 187: 228-31(1965). (In German).

Several of the interesting new relations in elementary particle physics, discovered from the hypothesis of SU_6 symmetry of strong interactions, are shown to follow from the less restrictive assumption of SU_4 symmetry alone. Since isospin invariance is a much more closely obeyed symmetry than SU_3, these relations may be the best tests for the validity of combining internal symmetries with spin. (auth)

43187 PHOTOPRODUCTION OF POSITIVE PIONS NEAR THRESHOLD IN HYDROGEN (thesis). Simpson, James David. Urbana, Ill., Univ. of Illinois, 1964. 61p.

An experiment was performed to improve available measurements of π^+ photoproduction cross sections very near threshold. To do this, a 14 in. hydrogen bubble chamber was used in an x-ray beam with $E_{max} \approx 230$ Mev. Meson tracks could be observed from their origins in the photon beam. Only those events were used in which the π^+ stopped and decayed in the visible region of the chamber. To suppress electron background, the x-ray beam from the University of Illinois betatron was hardened before it passed through the bubble chamber. Each x-ray pulse contained a total energy of about 10^8 Mev. A special high pressure ion chamber was used to monitor the beam flux. The uncertainty in the calibration of the monitor is about 2.4%. From 435,000 sets of photographs, about 9100 usable photoproduction events were found. The scanning efficiency appears to be greater than 99%. The 90° center-of-momentum matrix-element-squared was found to agree well with an evaluation of the theoretical prediction of Chew, Goldberger, Low, and Nambu (CGLN). The threshold value for the a_0 coefficient was found to be 21.1 ± 0.8 μb/str. In conjunction with the theoretically predicted value for the minus-to-plus ratio and using a theorem by Kroll and Ruderman, a value of .0788 ± .0030 was obtained for the re-normalized pion-nucleon coupling constant. (Dissertation Abstr.)

43188 PHOTOPRODUCTION OF CHARGED PIONS FROM DEUTERIUM NEAR THRESHOLD (thesis). Yoon, Taek-Soon. Urbana, Ill., Univ. of Illinois, 1964. 85p.

An experiment was performed in order to improve existing information on the behavior of the π^--photoproduction cross section near threshold. To do this an x-ray beam from the University of Illinois betatron was passed through a 14 inch liquid deuterium bubble chamber. Each x-ray pulse ($E_{max} = 230$ Mev) contained a total energy of about 10^8 Mev. The x-ray beam was hardened by means of a standard beam hardening technique to reduce the electron background. The x-ray beam monitor was calibrated with an uncertainty of ±2.4%. A total of 140,000 usable photographs were taken. About 5400 π^--photoproduction events and about 2700 π^+-photoproduction events were found. Each π^--event was identified by a kinematic fitting of the vertex, and each π^+-event was identified by a characteristic π-μ decay signature. Results were compared with Baldin's impulse approximation calculations in order to obtain the matrix element for the π^--photoproduction process from a free neutron. The result, however, was found to be sensitive to the so-called cut-off parameter. The π^- to π^+ ratio was determined for seven pion laboratory energy and angle bins, using the π^+-events observed in deuterium. Coulomb corrections were applied to these results. A Chew-Low unstable target extrapolation procedure was used in order to obtain the cross section for the π^--photoproduction process from a free neutron. A correction factor was calculated to eliminate the effects of the Coulomb interaction and specific nuclear force interaction of the recoiling protons in the final state. The result of this analysis agrees with the CGLN theory evaluated with a coupling constant $f^2 = 0.073 \pm .003$ and $N^{(-)}$ being set to zero. The extrapolation to threshold was carried out using the cross section shape predicted by CGLN. The threshold value of $a_0^{(-)}$ was found to be 26.0 ± 1.0 μb/ster. Comparing this with the result of the latest π^+ experiment at the University of Illinois, the threshold σ^-/σ^+ ratio was found to be 1.23 ± .06. (Dissertation Abstr.)

Field Theory and Quantum Mechanics

43189 POST-PAULI APPROXIMATIONS AND THE EINSTEIN-INFELD-HOFFMANN APPROXIMATION METHOD. Kossakowski, Andrzej (Nicholas Copernicus Univ., Torun, Poland). Acta Phys. Polon., 27: 815-20 (June 1965).

The non-unitary transformation used by Akhieser and Berestetskiĭ in the second-order approximation in the transition from Dirac's to Pauli's formalism is generalized to an arbitrary order of approximation. The related recurrence formulae are obtained in terms of the Einstein-Infeld-Hoffmann approximation method. (auth)

43190 AN ALGEBRAIC SPECTRUM CONDITION. Doplicher, S. (Universita, Rome; Scuola di Perfezionamento in Fisica Nucleare, Rome). Commun. Math. Phys., 1: 1-5(1965).

It is shown that a translationally invariant algebra $\mathcal{A}$ of local observables admits a representation in a Hilbert space having a vacuum state. Furthermore, an algebraic criterion is given which is necessary and sufficient for the existence of at least one representation of $\mathcal{A}$ in which the usual spectral condition for the energy-momentum operators holds. (auth)

43191 THE C*-ALGEBRAS OF A FREE BOSON FIELD. I. DISCUSSION OF THE BASIC FACTS. Kastler, D. (Universite Aix-Marseille, France). Commun. Math. Phys., 1: 14-48(1965).

A systematic description is given of several C*-algebras associated with a free Boson field. The structure of the one-particle space enters only through its symplectic form σ and a directed absorbing set of finite-dimensional subspaces on which σ is non-degenerate. The Banach*-algebras $L_1(\mathcal{F},\sigma)$ and $M_1(\mathcal{F},\sigma)$ of absolutely continuous resp. bounded measures on a finite-dimensional symplectic space $(\mathcal{F},\sigma)$, with their "twisted convolution product" stemming from Weyl's commutation relations, are studied as the analogues of the L_1 resp. M_1 algebras of a locally compact group. The fundamental "vacuum idempotent" Ω determines their (unique) Schrödinger representation, Schrödinger A*-norm and Schrödinger C*-completions $\overline{L_1}(\mathcal{F},\sigma)$ and $\overline{M_1}(\mathcal{F},\sigma)$. After a study of these one proceeds to a construction as an inductive limit of the algebras $M_1(\mathcal{H},\sigma)$ and $\overline{M_1}(\mathcal{H},\sigma)$ for an infinite-dimensional symplectic space $(\mathcal{H},\sigma)$. The "Fock representations" (with the corresponding "field operators") are presented as the infinite-dimensional generalization of the Schrödinger representation. Finally, several possible choices for the free Boson C*-algebra are discussed. (auth)

43192 ON THE STRUCTURE OF THE ALGEBRA OF FIELD OPERATORS. II. Borchers, H. J. (Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France). Commun. Math. Phys., 1: 49-56(1965).

The global structure analysis of local field operators is reinvestigated. (auth)

43193 ON THE VACUUM STATE IN QUANTUM FIELD THEORY. II. Borchers, H. J. (Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France). Commun. Math. Phys., 1: 57-79(1965).

For every local irreducible quantum field theory that fulfills the spectrum condition, an associated theory is constructed which satisfies the spectrum condition and is physically equivalent to the given theory and in which the representation space contains a vacuum state. (D.C.W.)

43194 A THEOREM CONCERNING THE POSITIVE METRIC. Robinson, Derek W. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Commun. Math. Phys., 1: 89-94(1965).

It is proved that if the n-point correlation functions of a system vanish for all $n > N$, then they vanish for all $n > 2$. The theorem is valid for a wide variety of formalisms, and an explicit proof is given for a Bose system with the canonical commutation relations. A proof is outlined for a relativistic field theory of the Wightman type. The essential property used in the proof is the positive definite metric. (auth)

43195 ON THE CONNECTION BETWEEN THE LSZ AND WIGHTMAN QUANTUM FIELD THEORY. Hepp, Klaus (Inst. for Advanced Study, Princeton, N. J.). Commun. Math. Phys., 1: 95-111(1965).

The LSZ asymptotic condition and the Yang-Feldman equations are derived in a Wightman quantum field theory on a dense set of scattering states. The Green's distributions are shown to be sufficiently regular around the energy shell to give well-defined reduction formulas for the scattering amplitudes. (auth)

43196 DIVERGENCE OF PERTURBATION THEORY FOR BOSONS. Jaffe, Arthur (Princeton Univ., N. J.). Commun. Math. Phys., 1: 127-49(1965).

Perturbation theory is studied in two-dimensional space-time. There all non-derivative boson self-interactions are renormalizable; and in each order of perturbation theory there are no divergences—all renormalizations are finite in perturbation theory. Thus, the unrenormalized perturbation series may be studied, and it is shown that any interaction of the general form $H_1(x) = \lambda \sum_{j=2}^{m} a_j \times :\varphi(x)^j :$, $a_j \geq 0$ leads to Green's functions which are not analytic in λ at $\lambda = 0$. This result holds in momentum space at a large set of points, enough to show that the Green's functions are not distributions in the momenta which are analytic in λ at $\lambda = 0$. Furthermore, the proper self-energy and the two-particle scattering amplitude are shown not to be analytic in λ at $\lambda = 0$ for certain momenta on or below the bare mass shell. In the course of this analysis, the integral representations for Feynman graphs are used to derive a minorization of the form $|I(p_1, \ldots, p_e)| > AB^n$ for the contribution from all n^{th} order connected graphs in a theory with an interaction of the form $H_1(x) = \lambda \sum_{j=3}^{Q} a_j : \varphi(x)^j :$. Then the constants A and B depend only on the momenta p_i, and not on the structure of a particular graph. (auth)

43197 SYMMETRICAL COUPLING OF THREE ANGULAR MOMENTA. Levy-Leblond, Jean-Marc; Levy-Nahas, Monique (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). J. Math. Phys. (N. Y.), 6: 1372-80(Sept. 1965).

A coupling scheme for three angular momenta is introduced. It relies on the properties of an operator which depends "democratically" upon the three individual angular momenta; this is in fact their mixed product. This operator, the total angular momentum, and one of its components form a complete set of commuting observables. In the case where the three individual angular momenta are equal, the eigenstates of this set possess remarkable symmetry properties with respect to the permutation group S_3. (auth)

43198 THE GRAVITATIONAL COMPASS. Szekeres, P. (Univ. of London). J. Math. Phys. (N. Y.), 6: 1387-91(Sept. 1965).

A purely covariant approach to general relativity, using the equation of geodesic deviation, is adopted. The physical interpretation is essentially that due to Pirani, but instead of using clouds of particles to analyze the gravitational field, a "gravitational compass" is proposed which fulfills the same purpose. Particular attention is focussed on the different roles played by the matter and the free gravitational field. The latter splits up conveniently into a superposition of a transverse wave component, a longitudinal component, and a "Coulomb" field, all of which introduce "shearing" forces on the gravitational compass, while the matter contributes a general contraction. Applications to the Friedmann cosmological models and the problem of interacting gravitational waves are discussed. (auth)

43199 THEOREM ON NONRADIATIVE ELECTROMAGNETIC AND GRAVITATIONAL FIELDS. Papapetrou, A. (Princeton Univ., N. J.). J. Math. Phys. (N. Y.), 6: 1405-10(Sept. 1965).

A vacuum electromagnetic field is considered which is stationary below a hypersurface Σ intersecting all parametric lines of the time coordinate t and is nonradiative above Σ. It is proved that such a field is also stationary above Σ. The same theorem is proved to be valid for the pure gravitational field in general relativity and for the combined gravitational and electromagnetic field in the Einstein–Maxwell theory. (auth)

43200 ON THE RENORMALIZATION GROUP. Nilsson, J. (Chalmers Tekniska Hoegskola, Goteborg). Nuovo Cimento (10), 39: 84-112(Sept. 1, 1965).

The origin of the renormalization group is re-examined, and various applications of the theory are discussed. Attention is focused on the limitations of these methods, and it is found that supplementary conditions are required besides the group equations in order to get unique results. These additional conditions on the solutions form the real basis for whatever physical information one may extract. Therefore, proper attention must be paid to these questions to ensure results which have physical meaning. In many recent applications these aspects have been overlooked, however, and inconsistent assumptions have been introduced. In some cases it is found that the essential results may be obtained under weaker conditions. It remains to be shown that these weaker conditions are consistent with the particular field theory model under consideration. (auth)

43201 PHYSICAL INTERPRETATION OF GENERALIZED CONSERVATION LAWS. O'Connell, R. F. (Oak Ridge National Lab., Tenn.); Tompkins, D. R. Nuovo Cimento (10), 39: 391-4(Sept. 1, 1965). (ORNL-P-1461).

Insight into the physical interpretation of the generalized conservation laws is given. It is shown that all the usual conservation laws in the number operator formalism may be written down very simply in one equation. The Dirac field is used as an example, but the procedure developed applies to all fields. The results are obtained without the use of lagrangian theory. It is seen that the existence of an infinite number of conserved quantities is dependent on the fact that the fields are noninteracting. (M.J.T.)

43202 INVARIANCE GROUPS AND CONSERVATION LAWS IN LINEAR FIELD THEORIES. Steudel, H. (Arbeitsgruppe fuer Grundlagenforschung der Theorie der Teilchen und Felder, Berlin). Nuovo Cimento (10), 39: 395-7(Sept. 1, 1965).

It is hypothesized that all of the infinite number of new conservation laws in linear field theories (up to the addition of trivially conserved quantities) are derivable by the Noether theorem. This hypothesis is proved for a certain class of these laws; thus an independent method for deriving the supplementary conservation laws is found. (M.J.T.)

43203 HADAMARD'S CLASS OF GREEN'S FUNCTIONS IN REGULARIZED g φ^4 THEORY. Marinaro, M. (Universita, Naples). Nuovo Cimento (10), 39: 401-4(Sept. 1, 1965).

The analytic properties of the n-particle Green functions $G_N(x_1 \ldots x_N)$, functions of the propagation kernels in scalar field theory with g φ^4 self coupling, are investigated directly. It is shown that G_N is also a nonanalytic function of g of at least the Hadamard class 2 of nonanalytic functions. This result is then extended to the suitably regularized theory of a neutral scalar meson self-coupled with a g φ^4 interaction. (M.J.T.)

43204 CONDENSATION IN FINITE ASSEMBLIES OF NON-INTERACTING BOSE-EINSTEIN PARTICLES. Goble, D. F.; Trainor, L. E. H. (Univ. of Toronto). Phys. Letters, 18: 122-3(Aug. 15, 1965).

Previous calculations of the ground state occupation for an ideal Bose-Einstein gas as a function of temperature are extended to include several thermodynamic functions, such as the chemical potential and the specific heat. The results are shown for finite assemblies using mass and density parameters for liquid ^{4}He. (L.B.S.)

43205 CONFORMAL GROUP AND ITS CONNECTION WITH AN INDEFINITE METRIC IN HILBERT SPACE. Kastrup, H. A. (Univ. of California, Berkeley). Phys. Rev., 140: B183-6(Oct. 11, 1965). (UCRL-16151).

It is shown that from any unitary representation of the 15-parameter conformal group, with the scalar product (f_1,f_2), another representation can be constructed in the same linear space with the indefinite metric (f_1,Rf_2). R is the operator which represents the transformation by reciprocal radii in that space. Its eigenvalues are ± 1. In the momentum space of the Klein-Gordon equation without rest mass, R is essentially the Hankel transformation and its eigenfunctions are Laguerre's functions. The new representations solve the problem of representing the dilatations in Hilbert space and lead to a less singular quantization in field theory. The canonical δ function in momentum space is replaced by a Bessel function of order zero. (auth)

43206 PLACE OF HILBERT SPACE IN S-MATRIX THEORY. Taylor, John R. (Princeton Univ., N. J.). Phys. Rev., 140: B187-91(Oct. 11, 1965).

Properties of the S matrix usually regarded as essential to an analytic S-matrix theory are shown to be sufficient for the construction of a Hilbert space of asymptotic states and a unitary S operator which maps this space onto itself. This means that, contrary to what one might expect, a formulation of S-matrix theory which makes no explicit reference to Hilbert space is in no sense more general than a more conventional formulation in terms of Hilbert space. (auth)

43207 ON A CONVERGENT MODEL OF QUANTUM ELECTRODYNAMICS. III. Ferwerda, H. A. (Rijksuniversiteit, Groningen, Netherlands). Physica, 31: 613-28(May 1965).

Two applications are given of a regularized model of quantum electrodynamics which was discussed previously. The regularization consists of the introduction of an elementary length for the electron. The effects calculated are the anomalous magnetic moment of the electron and the Compton effect for free electrons both in lowest order of perturbation theory. It turns out that an elementary length of about 6.2×10^{-13} cm would give rise to an anomalous magnetic moment which no longer agrees with the experimental value within the limits of accuracy. An elementary length of about 6.2×10^{-13} cm would give corrections of the order of 0.02% to Compton scattering of free electrons. A discussion is given of the photon mass. It is shown that one has to introduce a counterterm in the lagrangian for the photon. (auth)

43208 THE THREE PARTICLE COLLISION OPERATOR IN QUANTUM MECHANICS. Resibois, P. (Universite, Brussels). Physica, 31: 645-70(May 1965).

The quantum mechanical collision operator for three incident free particles is analysed from the point of view of transport theory. Starting from the Liouville-von Neumann equation for the density matrix, in the form introduced previously by Prigogine and coworkers, the generalization to quantum systems of the well known Choh-Uhlenbeck result for classical genuine triple collisions is obtained. This expression, written in terms of the Heisenberg operators of motion exp [-iHt] for two and three particles, is free of the divergence difficulties occurring in standard collision theory when the limits of a large system and of long times are taken in order to define a three particle transition probability. The connection of this result with the Lippman-Schwinger theory is also discussed; and it is shown that the scattering operator for three incident particles is not expressible as the square of a scattering matrix, like in the two particle problem. (auth)

43209 WAVE PACKETS IN MANY ELECTRON SYSTEMS. Brun Hansen, E. (Universitetsparken Koebenhaven, Denmark). Physica, 31: 908-14(June 1965).

The meaning of a wave packet in a many electron system is considered in detail. It is shown that the lower limit for the extension of a many electron wave packet with average excitation energy E_θ is $b = v_F \cdot \hbar/E_\theta$ (v_F = Fermi velocity). Taking $E_\theta = kT$ with T = 10°K, gives $b \simeq 10^{-4}$ cm or 10^4 Å (i.e. $\sim 10^4$ times the de Broglie wavelength) for the wave packet extension in a typical metal. This large value is due to the fact that the occupied states below the Fermi level cannot be used in building up the wave packet. It is shown that this result implies that transport theory is valid even in cases where the mean free path is smaller than the width of the wave packet. (auth)

43210 ENERGY AND MOMENTUM IN GENERAL RELATIVITY. III. THE TOTAL ENERGY, MOMENTUM AND ANGULAR MOMENTUM OF AN ISOLATED FINITE SYSTEM GENERATING GRAVITATIONAL WAVES. Cornish, F. H. J. (Univ. of Leeds, Eng.). Proc. Roy. Soc. (London), Ser. A, 286: 270-84(June 22, 1965).

A theory of energy and momentum is applied to the solution for the metric field obtained by Sachs (Proc. Roy. Soc. A, 270: 103(1962) and Phys. Rev. 128: 2851(1962)) for an isolated bounded source generating gravitational waves in space-time that is asymptotically flat. Expressions are found for the total 4-momentum and angular momentum of the field and source. The total energy agrees with the expression identified by Sachs as the mass of the system. Both the flux of 4-momentum and the flux of angular momentum to infinity are determined by a single complex function of three variables, and they both vanish when the time derivative of this function is zero. Within the group of allowed transformations discussed by Sachs the 4-momentum flux to infinity is given uniquely. (auth)

43211 VARIATIONAL PRINCIPLES IN THE COUPLED CHANNEL N/D METHOD. Kikkawa, Keiji (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 33: 1107-15(June 1965).

Various variational principles are explicitly presented for the N and/or D amplitudes in the dynamical S-matrix theory. When the generalized potentials (the left-hand discontinuities of the partial wave amplitude) are given, the upper and lower bounds of the inverse reaction matrix, K^{-1}, in both single and coupled channel cases, are discussed from the viewpoint of the variational method. The crossing relation or the self-consistency requirements are not discussed. (auth)

43212 A REMARK ON THE NORM OF THE UNSTABLE STATE, A ROLE OF ADJOINT WAVE FUNCTIONS IN NON-SELF-ADJOINT QUANTUM SYSTEMS. Hokkyo, Noboru (Hitachi Central Research Lab., Tokyo). Progr. Theoret. Phys. (Kyoto), 33: 1116-28(June 1965).

The theory of adjoint functions developed in the treatment of non-self-adjoint systems such as nuclear reactors is applied to quantum systems, and a method of normalizing wave functions describing unstable decaying states is presented. (auth)

43213 ON THE BOUNDARY CONDITIONS IN GENERAL RELATIVITY. Nariai, Hidekazu (Hiroshima Univ.). Progr. Theoret. Phys. (Kyoto), 34: 173-86 (July 1965).

The attempt is made to derive a suitable set of boundary conditions in general relativity from the standpoint that Einstein's field equations to be constructed from the combined metric tensor, which is defined as a linear combination of two metric tensors specifying two adjacent regions by making use of the step-function, must be free from any kind of delta-singularities. The analysis is performed in a system of coordinates relative to which the boundary surface of the two regions is at rest. Then it is shown that the metric tensor and its first derivative must satisfy the boundary conditions which are identical with the counterparts in O'Brien-Synge's approach. However, in order that Einstein's equations thus obtained may be consistent with the law of conservation, the energy-momentum tensor

must satisfy a new boundary condition as well as the remaining ones in O'Brien-Synge's approach. (auth)

43214 CANONICAL QUANTIZATION OF A REGULARIZED WAVE EQUATION IN A NEW ANTIPARTICLE CONCEPT. Bopp, Fritz (Universitaet, Munich). Z. Physik, 186: 410-43(1965). (In German).

According to the new concept of antiparticles, the energy is equal to the modulus of the frequency, and the eigenvalues of the Schrödinger operators are primarily frequencies. Orthodox canonical quantization of appropriately chosen classical Lagrangian densities (i.e., in a Hilbert space of positive definite metric) is then found to yield finite results without the use of an artifice. The new concepts are applied to a realistic regularized spinor field equation derived from a Schrödinger operator formally related to that of Heisenberg's field theory. In this case, canonical quantization leads to wave equations in the configuration space. The so-called mathematical vacuum is the same as the physical vacuum, and the bare particles are real ones. The two-particle problem can be integrated in full rigor. In particular, the binding and scattering of two particles is investigated. The latter includes a process comparable with the muon decay $\mu^- \rightarrow e^- \nu \bar{\nu}$, as is to be expected on the grounds of crossing symmetry. It remains to be seen how far the wave equation, introduced in an ad hoc manner, represents more than just a model. Undoubtedly it describes a possible relativistic world, in fact a world for which nontrivial results can be derived. For some special processes, binding energies, cross sections, and decay constants are calculated. On the basis of the new concepts, the vacuum in relativistic quantum theory is independent of the interaction, just as in the nonrelativistic theory. This ought to simplify the inclusion of new symmetry properties. (auth)

43215 RELATIVITY: THE SPECIAL THEORY. Second Edition. Synge, J. L. Amsterdam, North-Holland Publishing Co., 1965. 470p.

Available in U. S. from John Wiley and Sons., New York for $14.00.

The principles of relativity are presented in terms of the geometry of space-time. The mechanics of a particle, a discrete system, and a continuum are treated as well as the electromagnetic field in vacuo. (D.C.W.)

Geophysics

43216 (AD-425787) ON THE POSSIBILITY OF PRODUCING ARTIFICIAL AURORAS. Scientific Report No. 4. Lanza, Giovanni (Northeastern Univ., Boston, Mass.). June 28, 1963. Contracts AF19(604)-7358 and AF19(604)-8462. 22p. (AFCRL-63-641). CFSTI $1.60 cy, $0.50 mn.

The possibility of producing artificially an aurora in a weakly ionized gas, which is under the action of an alternating electric field of proper frequency, and of a constant magnetic field, is theoretically considered. (M.O.W.)

43217 (NASA-CR-281) MAGNETOHYDRODYNAMIC WAVES IN A PLASMA SLAB. Cooper, Elisabeth A. (California Univ., Berkeley). Aug. 1965. 27p. CFSTI $2.00 cy, $0.50 mn.

A study was carried out on the propagation of magnetohydrodynamic waves in a plasma bounded by a vacuum or a neutral gas, in order to improve understanding of the propagation of these waves in the magnetosphere and their characteristics as observed on the surface of the earth. For simplicity a two-dimensional problem, consisting of a magnetized plasma bounded by two planes, is considered. (M.O.W.)

43218 (NASA-TN-D-2798) GODDARD SPACE FLIGHT CENTER CONTRIBUTIONS TO THE COSPAR MEETING, MAY 1964. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). July 1965. 179p. CFSTI $5.00 cy, $1.00 mn.

Twelve papers are included; separate abstracts have been prepared for 4. Five of the papers were previously abstracted in NSA, 18: 42528, and 19: 8125, 8126, 35307, and 37705. The three papers not abstracted separately cover the physics of the earth's upper atmosphere. (T.F.H.)

For abstracts of individual papers see: 43019, 43219–43220, and 43226.

43219 (NASA-TN-D-2798, pp 37-50) NEW KNOWLEDGE OF THE EARTH'S ATMOSPHERE FROM THE AERONOMY SATELLITE (EXPLORER XVII). Spencer, N. W.; Newton, G. P.; Reber, C. A.; Brace, L. H.; Horowitz, R. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center).

The Explorer XVII satellite performed direct, localized measurements of the total neutral particle density, the concentration of neutral particle masses 4, 14, 16, 28, and 32, and the temperature and concentration of thermal electrons, between the altitudes of 258 and 920 km, in particular between ±58° latitude. Pressure gages on the satellite showed that the total density at 280 km was about 50 percent lower than is given by the appropriate atmospheric models based on satellite drag measurements. Daily variations in total density are strongly dependent on a_p (the magnetic index). Neutral mass spectrometers show that He is the predominant neutral constituent above 600 km, O is predominant between 250 and 600 km, and N_2 is predominant below 250 km. The scale heights of the various constituents agree in general with the corresponding model atmospheric scale heights. Langmuir probe results confirm the global extent of thermal non-equilibrium ($T_e > Tg$) and provide high resolution of the diurnal variation of electron temperature and density at several stations. For example, the electron temperatures near the F_2 maximum over Blossom Point show a nighttime value of about 1100°K, followed by a mid-morning maximum of 2800°K and an afternoon plateau of 2200°K. A consistent and strong latitude effect, evident particularly at Blossom Point, caused a significant positive gradient in electron temperature (the order of 25°K/degree of latitude) and an inverse gradient in electron density in a manner approximately in accord with theory. (auth)

43220 (NASA-TN-D-2798, pp 51-62) THE TEMPERATURE OF CHARGED PARTICLES IN THE UPPER ATMOSPHERE. Bourdeau, R. E. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center).

Three general methods of investigating charged particle temperatures in the upper atmosphere have been used: direct measurements from rockets and satellites; indirect determination using electron scale heights measured from rockets and satellites; and ground-based radar incoherent backscatter experiments. The latitude, altitude, and temporal trends of these results are reviewed and the implications discussed. Observations by all three methods are consistent in showing that the electron temperature increases with latitude for both daytime and nighttime conditions. Moderate differences between the daytime electron and neutral gas temperatures are indicated to altitudes well above the F2 peak for a winter mid-latitude ionosphere at an epoch between solar maximum and solar minimum conditions. Much larger daytime differences are observed for summer months and for solar minimum conditions. All of these trends reflect corresponding changes in the electron density. The daytime observations are consistent with ultraviolet radiation as the predominant heat source if the possibility of photoelectrons diffusing along magnetic field lines and depositing their excess energy elsewhere is included. A nighttime heat source (small compared to the daytime ultraviolet effect) is required to explain the observations. (auth)

43221 (USNRDL-TR-866) PRELIMINARY COMPUTER PROGRAM FOR ESTIMATING PRIMARY IGNITION RANGES FOR NUCLEAR WEAPONS. Martin, S. B.; Holton, S. (Naval Radiological Defense Lab., San Francisco, Calif.). June 3, 1965. 77p.

A machine computer program is described for estimating the free-field, primary incendiary effects of nuclear weapons detonated under a variety of environmental conditions.

The computational procedures are designed to treat: the dependence of thermal pulse duration on air density, up to 20 or 30 miles altitude; the dependence of radiant exposures required to ignite kindling fuels on pulse duration, local humidity, and the physical properties of the fuel; the attenuation of thermal radiation by the atmosphere for a variety of atmospheres including clouded and hazy; and the enhancement of radiant exposure levels by high albedo surfaces such as snow and cloud cover. Output of the program takes the form of radiant exposure contours and primary ignition ranges expressed as horizontal distances from the burst point (or surface zero) in miles. (auth)

43222 GRAVITATIONAL RADIATION FROM A PULSE OF LIGHT. Westervelt, Peter J. (Brown Univ., Providence). Acta Phys. Polon., 27: 831-41(June 1965).

The gravitational field generated by a pulse of light is calculated in the Einstein weak-field approximation. By properly accounting for energy and momentum conservation at the light source, this gravitational field necessarily satisfies the usual auxiliary conditions, a feature lacking in earlier analyses. The equations of motion for a zero-pressure fluid of uniform density μ_0 acted upon by this gravitational field are then solved to obtain the total momentum communicated to the fluid. Following Zwicky, the momentum of the fluid is said to be gained at the expense of the momentum of the light pulse; this leads to the conclusion that the momentum of the light pulse decreases with the square of l, the distance traveled by the light pulse. Applied to a single photon, this analysis leads to a red-shift law for which the fractional increase in wave length is: $\Delta\lambda/\lambda = {}^2/_3\ \pi\mu_0 c^{-2} k l^2$, in which k is the gravitational constant. (auth)

43223 CONFORMAL GEODESIC DEVIATIONS. [PART] I. Plebanski, Jerzy (Instituto Politecnico Nacional, Mexico City). Acta Phys. Polon., 28: 141-73 (July 1965).

The theory of geodesic deviations of arbitrary spinor-tensor densities is developed first on the level of the affine then on the level of the conformal geometry. Equations of the falling elevator (of the first order) and of the two infinitesimally close falling elevators are studied. The possibility of the geometrical interpretation of the algebraic types of the curvature with the help of these equations is discussed. (auth)

43224 STUDY OF THE PROPAGATION OF A SHOCK WAVE AND OPTICAL PHENOMENA OBTAINED FROM EXPLOSIONS IN THE IONOSPHERE. Blamont, Jacques Emile; Boubli, Yolande (C.N.R.S., Paris). Ann. Geophys., 21: 68-79(Jan.-Mar. 1965). (In French).

Exogene tolit was exploded in the ionosphere at 90, 110, 160, 170, and 180 km. The rate of expansion of the shock wave was measured photographically and was found to obey an expansion law of the form $R = At^{\frac{1}{4}}$. The data fit the theoretical curve obtained from the method of Keller. The Mach number at 10^{-2} sec ranges from 11 for 35 kg at 110 km to 2.5 for 3 kg at 170 km. An electronic method was also used to determine the rate of expansion of the wave; this method gave results greater than the photographic method by a constant amount. Possible causes of the discrepancy are suggested. Pressure, temperature, and density ratio at the front are calculated; and the electronic density assuming known temperature is calculated. All these values are tabulated. Further studies were made of the turbulence at 90 km, the rate of polarization of scattered solar light, emission spectrum of the explosion, integrated thickness of atmospheric O_3, the diffusion coefficient in the atmosphere from 90 to 110 km, variation in density at these altitudes, and speed and direction of the winds from 90 to 160 km. Data are either tabulated or graphed. (BBB)

43225 SATELLITE SCINTILLATION OBSERVED IN THE AURORAL ZONE. Liszka, Ludwik (Kiruna Geophysical Observatory, Sweden). Arkiv Geofysik, 4: 211-25(1963).

Earlier results suggest that both satellite and radio-star scintillation in moderate geographic latitudes is produced in the F-region of the ionosphere. However, observations of auroral zone satellite scintillation have shown that a considerable proportion is associated with the occurrence of the auroral sporadic E-layer. Observations made at frequencies of 20 and 54 Mc/sec on the following satellites are presented: Sputnik III, Explorer VII, Discoverer 32, and Transit IV A. Emphasis is placed on the results obtained from Transit IV A, since they form a uniform series of measurements. The curve of diurnal variation of the scintillation index at 54 Mc/sec was dependent on geomagnetic activity, the average level of the curve being higher for disturbed than for quiet days. Maximum scintillation was observed around midnight. Seasonal variations of scintillation at 54 Mc/sec were considerably smaller than the day-to-day variations associated with magnetic activity. The depth and frequency of occurrence of scintillation decreased with observing frequency. However, scintillation at 54 Mc/sec seemed better correlated with magnetic activity than that at 20 Mc/sec. Scintillation of the same depth was associated with smaller geomagnetic disturbances during the night than during the day. Scintillation was correlated with the night-time auroral sporadic E. This fact together with the previous results indicates that there exists an important difference between daytime and nighttime scintillation, which may be produced by two different mechanisms. Nighttime scintillation appears to be associated with the lower ionosphere. (BBB)

43226 INITIAL RESULTS OF THE IMP I MAGNETIC FIELD EXPERIMENT. Ness, Norman F.; Scearce, Cleil S.; Seek, Joseph B. (Goddard Space Flight Center, Greenbelt, Md.). J. Geophys. Res., 69: 3531-70(Sept. 1964). (NASA-TN-D-2798).

The Interplanetary Monitoring Platform (IMP I), Explorer XVIII (1963 46A), launched on November 27, 1963, provided the first accurate measurements of interplanetary magnetic fields. The initial apogee of the satellite was located 197,616 km on the sunlit side of the earth, with an apogee-earth-sun angle of 25°. Detailed measurements of the interplanetary magnetic fields and the interaction of the solar wind with the geomagnetic field have been performed. Initial results of the magnetic field experiment are presented. The strength of the interplanetary magnetic field is found to vary between 4 and 7γ with extreme values as low as 1 and as high as 10γ. The magnitude, however, is extremely stable over time scales of hours, although directional changes are significant. The average direction of the interplanetary magnetic field lies slightly below the plane of the ecliptic and approximately along the streaming angle predicted for a steady-state solar wind. A significant feature of the magnetic field measurements is the discovery of fields pointed diametrically opposite the streaming angle indicating filamentary structure of interplanetary fields. Associated with the fields of opposite direction are null surfaces between the filaments and in the overall field structure. The complex interaction of the solar wind and geomagnetic field shows a variety of significant magnetic field fluctuations and transition characteristics. The discovery, at 13.4 R_E, of the collisionless magnetohydrodynamic shock wave at the stagnation point associated with the super-Alfvénic flow of solar plasma, is one of the major results of this experiment. Details of the fluctuations are discussed as well as the gross structure and shape of the magnetospheric surface (10.2 R_E at the subsolar point) and the shock wave from the subsolar point to the nighttime geomagnetic tail. The transition region between the shock wave and the magnetopause is one of high turbulence in the magnetic field. A unique aspect of the magnetic field data is the detection of the magnetohydrodynamic wake of the moon during the fifth orbit when the satellite was eclipsed by the moon's magnetosphere while in interplanetary space. (auth)

43227 GEOGRAPHICAL AND SOLAR ACTIVITY VARIATIONS IN THE ELECTRON TEMPERATURE OF THE UPPER F-REGION. Willmore, A. P. (Univ. of London). Proc. Roy. Soc. (London), Ser. A, 286: 537-58(Aug. 3, 1965).

Electron temperature observations obtained in April–

July 1962 on the Ariel I satellite were further analyzed by a statistical method. The general increase of electron temperature with latitude (amounting to about 500 deg K) and with altitude between 400 and 1200 km, (ca. 600 deg K) previously reported, are confirmed. In addition, the dawn maximum of electron temperature found by other workers, which at the period of these observations is only a minor effect at 40° geomagnetic latitude, is found to become more pronounced near the magnetic equator. The geographical variations of electron temperature are shown to divide into distinct patterns characteristic of noon, dawn and midnight. The dawn pattern consists essentially of a longitude variation in the amplitude of the dawn maximum. All three patterns are closely associated with the geographical variations of electron density, and by examining the detailed correlation of temperature and density it is shown that the temperature variations result from changes in the collisional cooling rate of the electrons. This provides confirmation of the explanation of the dawn maximum suggested by Dalgarno, McElroy & Moffat (1963). Temperature variations due to changes in the far u-v emission of the sun are considered. By day it is found that the electron temperature increases with 2800 Mc/s solar emission at a rate of 4.6 ± 2.3°K per flux unit of 10^{-22} Wcm^{-2} $s^{-1}(c/s)^{-1}$, while at night it decreases at a rate of 2.3 ± 2.7°K/flux unit. Temperature variations in magnetic storms are compared with density enhancements described by Willmore & Henderson (1965). Electron density increases in the storm are always accompanied by a temperature reduction of about 180°K, the storm-time changes showing a distinct magnetic shell structure. An instance of a temperature increase near the Brazilian geomagnetic anomaly is also given. Finally, it is shown that these results lend support to the suggestion of a departure from thermal equilibrium in the night-time ionosphere. (auth)

43228 ON THE PROBLEM OF GRAVITATIONAL COLLAPSE. Nariai, Hidekazu; Tomita, Kenji (Hiroshima Univ.). Progr. Theoret. Phys. (Kyoto), 34: 155-72(July 1965).

A new approach to the problem of gravitational collapse is proposed, which is reasonable from the standpoint of fitting conditions at the boundary of a collapsing star, contrary to Oppenheimer-Snyder's original approach. The fitting is carried out on the basis of O'Brien-Synge's boundary conditions by using the system of co-moving coordinates even in the exterior region. Then it can be shown that Hoyle-Narlikar's procedure of fitting relying on the system of non-co-moving coordinates is, after a suitable reinterpretation, justified. However, the approach is superior to Hoyle-Narlikar's in the sense that the exterior solution extended maximally is free from Schwarzschild's singularity, thus the problem of hidden mass in stellar systems can be dealt with, because the singularity corresponds to a light cone in the space-time defined by the new metric. A new formula for the spectral shift applicable to the collapsing star is also derived, and its possible role in the explanation of large red-shift of star-like objects is referred to. (auth)

43229 ATMOSPHERIC STRUCTURE AND ITS VARIATIONS AT HEIGHTS ABOVE 200 km. Jacchia, Luigi G. (Smithsonian Astrophysical Observatory, Cambridge, Mass.). 39p. (CONF-650422-10). Gmelin, AED-CONF-65-118-31.

From American Geophysical Union, Program for Section of Seismology Annual Meeting, Washington, D. C.

A survey is made of the most important contributions to the study of atmospheric structure and its variations above 200 km. Density and temperature variations, caused by changes in solar euv radiation, variations correlated with geomagnetic activity, the diurnal variation, and semiannual variations are included. (64 references) (L.B.S.)

43230 THE PHYSICS OF PARTIAL RING CURRENT SYSTEMS. Cummings, David (Space Science Dept., Houston, Tex.). 8p. (CONF-650422-11). Gmelin, AED-CONF-65-118-32.

From American Geophysical Union, Program for Section of Seismology Annual Meeting, Washington, D. C.

The consequences of asymmetrical particle trapping in ring current belts are investigated. The simplest asymmetry of a local enhancement of particle energy density superimposed upon a uniform ring current belt is considered, assuming the partial ring current belt is centered in the equatorial plane, spanning both a small longitude and latitude. (L.B.S.)

Low Temperature Physics

Refer also to abstracts 42884, 42902, and 43495.

43231 (NASA-TN-D-2934) ANALYTICAL AND EXPERIMENTAL STUDY OF NUCLEAR HEATING OF LIQUID HYDROGEN. Anderson, Bernhard H.; Danilowicz, Ronald L. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). July 1965. 42p. CFSTI $2.00 cy, $0.50 mn.

In the experiments, which were performed in a 125-gallon tank positioned over a nuclear reactor, both the tank walls and the liquid hydrogen were heated by nuclear radiation. Experiments were performed where the total heating rate was varied from 177 to approximately 1000 watts. Experimental data were obtained over a range of flow discharge rates from 0.04 to 0.13 pound per second and ullage pressures of 30 to 60 psia. The results of this investigation showed that a portion of the nuclear heating generated within the tank walls caused convective motion of the hydrogen, which carried warm fluid to the liquid surface and formed a temperature gradient or stratified layer. In general, no gross changes in the flow behavior were observed over the range of test parameters. An approximate analysis was developed to predict the local temperature rise in a subcooled fluid, subjected to wall heating and internal absorption of energy, and discharging at constant flow rate and pressure. Comparisons between experiment and analysis indicate that the analysis can predict the temperature histories with reasonable accuracy. A study was made to determine the effects that the various analytical assumptions in the assumed flow model have on the calculated temperature history. Within the range of experimental test parameters, no appreciable error was introduced by considering the flow along the side walls to develop in a manner similar to the development of flow along a semi-infinite vertical flat plate. The position on the tank wall at which the boundary layer was assumed to initiate was arbitrarily varied to investigate its influence on the temperature profile in the tank. All of the heating below this position was assigned to bulk heating. The results indicate that varying this position had little effect on the temperature histories. (auth)

43232 MULTISHIELDING—AN ADVANCED SUPER-INSULATION TECHNIQUE. Paivanas, J. A.; Roberts, O. P., Wang, D. I-J. (Union Carbide Corp., Tonawanda, N. Y.). Advan. Cryog. Eng., 10: 197-207(1965).

A technique for reducing the evaporation from dewars with multiple layers of insulation is described in which refrigeration of the escaping vapor to a previously impractical extent is used. A number of vapor-cooled shields are used to isolate the inner vessel from the environment. (D.C.W.)

43233 THE PERFORMANCE CHARACTERISTICS OF SMALL SUPERCONDUCTING COILS. Laverick, C. (Argonne National Lab., Ill.). Intern. Advan. Cryog. Eng., 10: 105-12(1965).

Some results of an investigation of the performance of small superconducting coils are presented. Over forty different coil designs were studied in measurements involving over one hundred coils, and information was obtained on the variation of transit-ion current with some of the design parameters. Variations in performance with

changes in wire composition and size, interlayer spacing and insulation, wire coating, rate of charge, thermal environment, and with impact and vibration were assessed. (D.C.W.)

43234 BACKWARD SUPERCONDUCTING SWITCHING. Cohen, Hirsh; Odeh, Farouk (International Business Machines Corp., Yorktown Heights, N. Y.). J. Math. Phys. (N. Y.), 6: 1411-24(Sept. 1965).

A discussion is given of the initial speed at which superconducting material changes state according to the London electrodynamics. These transitions are taken to occur in the form of phase boundary motions. Phase changes from the normal to the superconducting state and vice versa are considered for the case in which the external magnetic field is radiated to the boundary of the superconducting material. A distinct difference is found in transition rates depending on whether the transition is from the superconducting or from the normal state. In another case considered, the transition from normal to superconducting is studied when the superconducting material is bounded by a good conductor. In all cases, constant critical field is taken as the switching criterion. The mathematical treatment involves the approximate solution of free boundary problems and mixed hyperbolic-parabolic boundary value problems. (auth)

43235 SUPERCONDUCTIVITY IN ZIRCONIUM-RHODIUM ALLOYS. Zegler, S. T. (Argonne National Lab., Ill.). J. Phys. Chem. Solids, 26: 1347-9(Aug. 1965).

Superconductivity in the Zr–Rh system is discussed. Transition temperature measurements and metallographic studies were made with alloys that were isothermally annealed for long times and water quenched. The alloys were prepared from zirconium crystal bar and 99.9+% pure Rh. The crystal bar was spectrochemically pure except for 30 ppm of Al, 40 ppm of Cu, 100 ppm of Fe, and 60 ppm of each B and Pb. The different phases of the alloys are discussed. The intermediate phase Zr–Rh was found to have normal conductivity down to 1.7°K. The data clearly demonstrated that superconductivity in the Zr–Rh system is sensitively dependent on both composition and structure. (F.J.H.)

43236 CONCERNING THE DESTRUCTION OF SUPERCONDUCTIVITY WITH DIRECT CURRENT. Berkovich, S. Ya.; Kan, Ya. S.; Rabukhin, L. B. JETP Letters (USSR) (English Transl.), 1: 108-9(May 15, 1965).

The transition from the superconducting state into the normal state and the inverse transition were investigated using unstressed single-crystal samples of tin. The resistance in the intermediate state exceeds the resistance in the normal state by 25 to 30% in the direct transition and by 65 to 70% in the inverse transition. The difference in the effect in the two cases can be attributed to the effect of Joule heat. It appears that the effect can be used to determine the fine structure of the intermediate state when superconductivity is destroyed with direct current. (D.C.W.)

43237 ON THE GRAND PARTITION FUNCTION OF A SUPERCONDUCTING FERMI SYSTEM. Canuto, V.; García-Colín, L. S. (Centro de Investigacion y Estudios Avanzados, Mexico City). Nuovo Cimento (10), 39: 113-25 (Sept. 1, 1965).

A particle-hole representation is used for constructing the grand partition function for a system of fermions with a superconductive attractive interaction. From the knowledge of this quantity the thermodynamic properties of interest are derived. It is shown that they agree with those obtained by Bardeen, Cooper, and Schrieffer when terms of the order of $\beta^{-n}(n > 1)$ are neglected. It is also shown that an equation of state does not exist in this limit. (auth)

43238 INFLUENCE OF THE RISE-TIME OF MAGNETIC FIELDS HIGHER THAN THE PENETRATION FIELD ON THE CRITICAL CURRENTS OF TYPE III SUPERCONDUCTORS. Weyl, R.; Dietrich, I. (Siemens and Halske AG, Munich). Phys. Letters, 18: 96-8(Aug. 15, 1965).

Cold-worked Nb-Ti(40 at.%), Nb-Ti(80 at.%), and Nb-Zr (25 at.%) with a high defect and dislocation concentration were used to study the influence of magnetic field rise-time on the critical values in the high-field region. Three sets of experiments were performed: quenching curves with and without overlapped constant field; dependence of the degradation on the delay-time of the current pulse in relation to the field pulse; and influence of copper coating. The results of all experiments indicated that the degradation was caused by thermal effects. An explanation of the heating effect is offered. (L.B.S.)

43239 FLUX ANNIHILATION IN HARD SUPERCONDUCTORS. Wischmeyer, C. R. (Rice Univ., Houston, Tex.). Phys. Letters, 18: 100-1(Aug. 15, 1965).

An annealed $Nb_{0.75}Zr_{0.25}$ sample was used to illustrate flux annihilation in cylindrical tubes of hard superconductors. It is contended that, besides dissipation associated with flux motion, the presence of an opposed trapped flux gives use to an additional dissipative process in which pairs of adjacent fluxions oppositely directed give up their line energies as heat. An estimate was made of the average volume power density characterizing the annihilation process, which was found to be in good accord with the observation of an increase in tendency toward instability with increasing penetration into the circular region. (L.B.S.)

43240 SUPERCONDUCTIVITY OF DILUTE MAGNETIC ALLOYS AT LOW TEMPERATURE. Nakajima, S. (Cambridge Univ., Eng.). Phys. Letters, 18: 107-8(Aug. 15, 1965).

The Abrikosov-Gor'kov theory on superconducting magnetic alloys is extended to include the case of low spin temperature, using a method which is a generalization of Eliashberg's theory of the electron-phonon coupling to which is added the exchange coupling of conduction electrons with localized impurity spins. An expression is derived for the energy gap as a function of the electron excitation energy ω, using the Einstein model. The model suggests that the gap parameter will exhibit an anomalous dispersion at $\omega = \omega_2$, where ω_2 is the Zeeman energy. (L.B.S.)

43241 SIMPLE MODEL CALCULATIONS ON POSSIBLE ORGANIC SUPERCONDUCTORS. Ladik, J. (Central Research Inst. for Chemistry, Budapest); Biczo, G.; Zawadowski, A. Phys. Letters, 18: 257-8(Sept. 1, 1965).

Attention is called to the possibility that a superconducting state can exist in some organic macromolecules via an interaction with such virtual excitations which do not change the original electronic distribution by a great amount. Simple model calculations were made on a polyene system and on a polyethylene model in which a long enough chain of ethylene molecules stacking on each other (not existing in nature) is supposed. The value 3.4 Å is taken as the distance of the planes of the superimposed ethylene molecules. In both calculations it is assumed that the interaction of the π electrons causes a band structure which was determined with the aid of the tight-binding approximation. From rough first estimates no superconducting state was obtained; but it is expected that by taking into account also interband scattering processes and considering systems with much larger numbers of σ bonds, such as DNA, a superconducting state may be obtained. (J.F.P.)

43242 ANGULAR-MOMENTUM EXPERIMENTS WITH LIQUID HELIUM. Reppy, John D.; Lane, C. T. (Yale Univ., New Haven). Phys. Rev., 140: A106-11(Oct. 4, 1965).

Angular-momentum measurements on helium I and helium II contained in a cylindrical vessel suspended from a virtually frictionless magnetic bearing are reported. Helium I behaves as a classical viscous fluid but the results for helium II are quite different. The latter shows two distinct types of behavior, either assuming an equilibrium state of solid-body-type rotation or else forming a metastable state wherein the liquid refuses to be excited into rotation. Both types of behavior are shown to be in accordance with predictions of the Onsager-Feynman hypothesis of quantized circulation in the superfluid. Data

are presented which seem to imply that macroscopic turbulence already present in the superfluid is a necessary condition for the generation of quantized vortex lines in this type of geometry. (auth)

43243 PHASE CHANGE IN ADSORBED HELIUM AT LOW TEMPERATURE. Goodstein, D. L.; Dash, J. G.; McCormick, W. D. (Univ. of Washington, Seattle). Phys. Rev. Letters, 15: 447-9(Sept. 6, 1965).

Specific data are presented for adsorbed helium in the temperature range from 0.25 to 4°K at several partial monolayer coverages. The results are interpreted as indicating the existence of two surface phases. The calorimeter consisted of a copper sponge prepared by sintering 3μ copper powder into a vacuum-tight copper container. Monolayer capacities for nitrogen and argon were measured by gas adsorption at 77°K and analyzed. The specific-heat results are given. It is found that a relatively small change in the surface density produces a qualitative change in the heat capacity. Crossing of the boundary from a two-phase into a single-phase region would be marked by a discontinuity in the heat capacity, but no discontinuity was seen. It was thought that perhaps the experimental range did not extend to high enough temperatures for this effect. (J.F.P.)

43244 NEW RELATIONSHIP BETWEEN THE CRITICAL FIELD AND ENERGY GAP OF A SUPERCONDUCTOR. Toxen, Arnold M. (IBM Watson Research Center, Yorktown Heights, N. Y.). Phys. Rev. Letters, 15: 462-3 (Sept. 6, 1965).

An interesting relation is pointed out between the critical field of a superconductor and its energy gap. The relation, which was derived empirically, may be stated in the following way: The magnitude of the slope of the reduced critical field of a superconductor at the critical temperature is equal to the energy gap of the superconductor at 0°K, measured in units of kT_c. Relevant superconducting quantities for several superconductors are listed; the energy gap at 0°K normalized to kT_c, the magnitude of the slope of the reduced critical-field curve at the critical temperature, and the ratio of the normalized energy gap to the slope. This relation is a useful one, for critical-field measurements can be carried out much more easily and accurately than tunneling measurements; and it provides a means for calculating energy gaps from critical-field measurements. (J.F.P.)

43245 THE PHASE DIAGRAM OF ^{3}He-^{4}He MIXTURES AT PRESSURES LARGER THAN THE SATURATED VAPOUR PRESSURE. Le Pair, C.; Taconis, K. W.; De Bruyn Ouboter, R.; Das, P.; De Jong, E. (Kamerlingh Onnes Laboratorium, Leiden). Physica, 31: 764-812(June 1965).

A full report is given of measurements of the onset of solidification, the onset of melting and the λ-transition of mixtures of ^{3}He and ^{4}He at pressures larger than the saturated vapor pressure. The measurements cover the complete concentration range: 0; 0.99; 2.77; 8.9; 22.8; 50.5; 64.5, and 80.1% ^{3}He. The apparatus and measuring techniques are described. The temperature range is 0.5–2.17°K. The pressure range is 0–48.4 atm. At low temperatures the freezing pressure of the mixtures is much lower than the weighted average of the freezing pressures of the pure substances. The difference can be as much as 9 atm. By entropy considerations this can qualitatively be explained. The freezing lines of the mixtures show steep minima, which can be understood by the same considerations. Some preliminary results of the temperature at which the volume minimum exists are given. Solidification is detected either by the blocked capillary technique, by observing kinks in pressure-temperature diagrams of constant amounts of fluid, or by watching the pressure as a function of temperature of a solidifying mixture in a flexible "Bourdon" vessel. The melting curves are detected by a special technique, which permits the following of the solidification of a mixture at constant temperature. From the measurements reported in the previous part a set of TX diagrams of ^{3}He–^{4}He mixtures at constant pressure were constructed. Peculiar properties such as: Azeotropy, phase stratification of the fluid and the solid, a polymorph phase transition in the solid and the λ-transition were taken into account. One, or perhaps two closed solid regions exist at pressures below 25 atm. The results are compared with those of several authors. (auth)

43246 SOME COMMENTS ON THE FLUID STATE AND THE SOLIDIFICATION OF ^{3}He AND ^{4}He AND AN EXPERIMENT ON THE MINIMUM IN THE MELTING CURVE OF ^{4}He. Le Pair, C.; De Bruyn Ouboter, R.; Pit, J. (Kamerlingh Onnes Laboratorium, Leiden). Physica, 31: 813-34(June 1965).

The fluid and the solid state are qualitatively discussed in terms of a random close-packing and a regular close-packing of spheres. The model is used to obtain values for the potential energies of fluid and solid. The calculation shows that the stability of the fluid phase at low temperatures cannot be ascribed to the potential energies of the two phases. Experiments are reported on the melting line of ^{4}He. A minimum is found at $T \approx 0.75$°K and a pressure of about 0.008 atm below the melting pressure at T = 0°K. The results are compared with those of several authors. (auth)

43247 TUNNELING BETWEEN SUPERCONDUCTORS—THE JOSEPHSON EFFECT (thesis). Baratoff, Alexis. Ithaca, N. Y., Cornell Univ., 1964. 141p.

The current-voltage characteristics of metal-insulator-metal junctions one (SN) or both (SS) sides of which are superconducting provide detailed information about the single particle spectrum of the superconductors involved. The structure of the insulating barrier is of no importance within the voltage range (10-100 mvolts) where the normal state characteristic is linear. The transmission coefficient is then very low (10^{-6}) and essentially independent of energy in the relevant range. The tunneling current is accurately given by first order perturbation theory on an effective hamiltonian involving a constant matrix element proportional to the normal state resistance of the junction. All interesting effects come from density of states factors $\rho = u(u^2-1)^{-\frac{1}{2}}$ and $(u^2-1)^{-\frac{1}{2}}$ where u, a function of the frequency variable ω, is the ratio of two quantities characterizing any theory of superconductivity (in the BCS model $u = \omega/\Delta_0$, where Δ_0 is the gap). The second type occurs in the expression for the zero-voltage supercurrent $I_s = J_s \sin\varphi$ due to the transfer of condensed electron pairs between the two sides (assumed superconducting). This effect, first predicted by Josephson, is crucially dependent on the existence of ensemble averages over states with no definite numbers of pairs on the two sides characterized by a definite value of the phase φ. The maximum supercurrent J_s can in general be expressed as a sum over the poles of the Fermi function or as a single integral over ω. The temperature dependence of J_s calculated in the BCS model is in good agreement with experiments on Sn–Sn and Sn–Pb junctions. Impurity effects were analyzed in detail. A single mathematical formalism due to Abrikosov and Gor'kov, more precisely a particular form of $u(\omega)$, describes all three situations, although in the last two cases one is limited to dirty thin films such that (mean free path) ≪ (thickness) ≪ (penetration depth) and (coherence distance). Extensive calculations of the dependence of the average Δ (order parameter), Δ_0 (energy gap), J_s and ρ are presented; Δ_0 is different from Δ and vanishes in a gapless region where superconductivity persists. Preliminary measurements of the d-c current-voltage characteristics of In(Fe)–Al junctions are in reasonable agreement with theory at low iron concentrations if a systematic tendency to overestimate Δ_0 is taken into account. Theoretical calculations of $j(v_s)$ at various temperatures are reported. The high v_s domain is accessible only if the supercurrent is induced around the cylinder as in flux quantization experiments. (Dissertation Abstr.)

43248 THERMAL CONDUCTIVITY OF FILMS EXHIBITING SURFACE AND POSITION-DEPENDENT SUPERCONDUCTIVITY. Seidel, T.; Meissner, H. (Stevens

Inst. of Tech., Hoboken, N. J.). 10p. (CONF-758-56). Gmelin, AED-CONF-65-003-117.

From American Physical Society Meeting, New York, Jan. 1965.

Measurements were made of the d-c electrical and thermal transitions of pure Pb films of thickness from 3 to 10 coherence distances in a parallel magnetic field, in order to characterize the behavior of the type $1\frac{1}{2}$ superconductor. Some results on multiple film systems are discussed, and some inferences are made. (L.B.S.)

43249 REFRIGERATOR EMPLOYING HELIUM. London, Heinz (to United Kingdom Atomic Energy Authority). U. S. Patent 3,195,322. July 20, 1965. Priority date Sept. 22, 1961, Great Britain.

A refrigerator is provided that is capable of operating at and maintaining a temperature lower than can be obtained by the method of evaporative cooling, i.e., a temperature lower than about 0.3°K. A volume of liquid He-3 is continuously diluted with liquid He-4 with heat being absorbed from a load to provide the heat of mixing. Desirably, the mixture of He-3 and He-4 is subjected to a distillation operation to maintain the proportion of He-3 below the equilibrium concentration to permit the He-3 continuously to dissolve in the He-4. Conveniently, the He-3 removed by the distillation operation is used for subsequent mixing with the He-4, thereby setting up a closed cycle. The continuous extraction of the He-3 may be effected by diffusion through the superfluid He-4 and subsequent evaporation from the He-4 at a temperature of about 0.6°K at which the vapor pressure of He-4 is negligible. (B.L.M.)

Neutron Physics

See also REACTOR TECHNOLOGY — Criticality Studies.

43250 (COO-917-15) ON CERTAIN COMMON APPROXIMATIONS IN THERMAL NEUTRON SCATTERING (thesis). Plummer, John Paul (Michigan Univ., Ann Arbor). 1964. Contract AT(11-1)-917. 154p. Dep. mn; CFSTI $5.00 cy, $1.00 mn.

Approximations normally made in thermal neutron scattering are considered. Separate chapters were devoted to the following: neutron scattering from an ideal classical gas — the Wigner-Wilkins kernel, neutron scattering from an ideal quantum gas — Van Hove's correlation functions, calculations of interference effects in neutron scattering from an ideal quantum gas, multiple scattering corrections to the Fermi approximation, in the static approximation, and chemical binding corrections to the Fermi approximation. A discussion of results follows. (M.O.W.)

43251 (KFK-304) TWO COMPACT, HIGH-INTENSITY PULSED NEUTRON SOURCES. Eyrich, W.; Schmidt, A. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). May 1965. 26p. (SM-62/4). Dep. mn.

For advanced neutron decay measurements and for time-of-flight application, higher neutron intensities are required than can be achieved with the conventional present-day Cockroft-Walton type neutron generators. In order to have a flexible device easily transportable to any experimental set-up, two types of small neutron generators were developed. An accelerator with stationary high voltage power supply operating with a pulsed duoplasmatron ion source was built. For long range applications a more ambitious neutron flash tube was developed which is based on pulsed r-f discharge combined with a pulsed acceleration voltage. Both accelerators produce 14 Mev neutrons from the $^3H(d,n)^4He$ reaction and use tritium targets. (M.O.W.)

43252 (LA-3349) DIFFUSION OF NEUTRONS FROM A POINT SOURCE IN AN EXPONENTIAL ATMOSPHERE. Rosenbluth, Marshall (Los Alamos Scientific Lab., Univ. of California, N. Mex.). June 1, 1956. Contract W-7405-eng-36. 9p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Equations are derived for the solution of the exponential atmosphere problem. Integrals are obtained for the case r = 0 (along the axis). It is found that the capture length at the height of burst should be short relative to the e-folding distance of the atmosphere, and that the critical height of burst is ~110,000 ft. (D.L.C.)

43253 (ORNL-TM-1204) MEASUREMENT OF THE NEUTRON DIFFUSION PARAMETERS IN ORDINARY ICE AS A FUNCTION OF THE TEMPERATURE BY THE METHOD OF TIME-DEPENDENT NEUTRON DIFFUSION (thesis). Silver, E. G. (Oak Ridge National Lab., Tenn.). Sept. 1965. Contract W-7405-eng-26. 400p. Dep. mn; CFSTI $7.00 cy, $1.75 mn.

Submitted to Univ. of Tennessee, Knoxville.

From its relatively large incoherent scattering cross section, ice should behave more like an amorphous medium than like crystalline beryllium or graphite. Thus the persistent spectrum-change effects that prevent establishment of a single-exponential decay following injection of neutrons into a small body of the moderator should be absent in ice, permitting the measurement of the diffusion parameters in ice by the method of time-dependent neutron diffusion. An experiment was conducted to test this hypothesis, and to measure the parameters $v\Sigma_a$, the absorption frequency; (vD), the diffusion coefficient; and C, the diffusion cooling coefficient, assuming asymptotic spectra to be attained. A series of accurately shaped uniform-density ice cylinders were prepared and subjected to repeated neutron pulses from a 300,000 ev deuteron accelerator using a deuterium target. The resulting decaying leakage flux was detected and its time-behavior examined by use of an eighteen-channel time-base analyzer. Analysis of the results reveals that asymptotic spectra are established, and therefore the diffusion parameters could be obtained. The absorption frequency was found to be independent of temperature over the experimental range of −5 to −85°C. This was expected in view of the (1/v) behavior of the absorption cross section. The value of $v\Sigma_a$ corresponds to $\sigma_a(H)(2{,}200\ m/sec) = 331.5 \times 10^{-3}$ b in good agreement with other measurements. The diffusion coefficient was found to vary linearly with absolute temperature according to the equation $(vD)(T^0K) = [(0.047 \pm 0.202) + (0.01225 \pm 0.0087) \cdot (T^0K)] \times 10^4\ cm^2\ sec^{-1}$. A small discontinuity in (vD) across the phase-boundary, inferred from this result, is explained in terms of known scattering cross sections. The diffusion cooling coefficient was found, within large error limits, to fit either a linear or exponential model. The latter is of the form $C(T) = (1.047 \pm 0.173)T^{\frac{1}{2}}$. The values of C suggest that the energy-transfer parameter M_2 is independent of temperature in the range measured. No large discontinuity in C across the phase boundary could be inferred from these results, in disagreement with results by two other investigators. Theoretical reasons for the observed behavior are suggested. (auth)

43254 THE UTILIZATION POSSIBILITIES OF THE 300 kv NEUTRON GENERATOR OF THE ATOMKI (INSTITUTE OF NUCLEAR RESEARCH). Bornemisza-Pauspertl, Panna. At. Kozlemen., 7: 47-55(Mar. 1965). (In Hungarian).

An account of the construction of the 300 kv rated voltage neutron generator working in the ATOMKI is presented. The output yield 3×10^9 or 2×10^8 n/sec with TiT and TiD targets, respectively, can be held practically constant for a considerable period. Laboratory angular distribution curves necessary for the designing and the evaluations of measurements, are given, at various accelerating voltages. The energy spread of the neutrons is given in the function of laboratory angles, for the comparison of measurements made at various voltages and angles, in the case of D-T reactions for two, in the case of D-D reactions for one deuteron energy. (auth)

43255 ON THE TRANSFER OF NEUTRONS IN A ONE-DIMENSIONAL STATIONARY CASE. Christov, Chr.; Rajchev, P. (Inst. for Physics and Atomic Research, Sofia). Izv. Fiz. Inst. s Aneb, Bulgar. Akad. Nauk., 12: 213-29 (1964). (In Bulgarian)

The diffusion equation of neutrons is derived in the one-dimensional stationary case, making the allowance that the neutron scattering in the medium may also be nonisotropic. If x is the depth of an infinite flat-parallel plate, measured off its middle surface, μ is cosine of the angle between the direction and the positive axis x, and $\psi(x,\mu)$ is the density of neutron flux in the plate, the problem is reduced to the following equation: $\mu\,[\delta\psi(x,\mu)/\delta x] + \psi(x,\mu) = \int_{-1}^{+1} p(\mu,\mu')\,\psi(x,\mu')\,d\mu'$, where $-1 \le \mu \le 1$, $-d \le x \le d$, with boundary conditions $\psi(-d,\mu) = \psi_{-+}(\mu)$, $\psi(d,-\mu) = \psi_{+-}(\mu)$, where d is half-thickness of the plate, while ψ_{-+} and ψ_{+-} are two fixed functions (densities of the neutron fluxes on the boundary surfaces of the plate). The parameter $p(\mu,\mu')$ is determined by the scattering qualities of the medium. The unknown constants c_p and function $c(\mu)$ are determined by the boundary conditions. (auth)

43256 THE DECAY OF EQUILIBRIUM NEUTRON FLUX INSIDE BERYLLIUM BLOCKS AT DIFFERENT TEMPERATURES. Goyal, I. C.; Kothari, L. S. Nucl. Sci. Eng., 23: 159-66(Oct. 1965).

Equilibrium-neutron energy spectra inside finite blocks of beryllium at different temperatures were calculated by solving the energy-dependent Boltzmann equation in the diffusion approximation by numerical iteration. Different sizes of the assembly were considered. The values of the transport mean free path, $\lambda_{tr}(E)$, (for various temperatures) were taken from earlier work. Because of the peaks in the transport mean free path, the calculated equilibrium flux differs markedly from the Maxwellian, particularly for small sizes and low temperatures. Calculations also give the values of the decay constant, λ, for equilibrium neutrons. Values of λ based on Placzek kernel agree very well with the experimental values. The reasons why the present calculated values, as also the experimental values of λ, exceed Corngold's theoretical upper bound were discussed. The effect on λ of "trapped neutrons" and that of cold neutrons also was studied by taking different forms for $\sigma_{tr}(E)$. (auth)

43257 EQUILIBRIUM SPECTRA AND DIFFUSION LENGTHS OF NEUTRONS IN SEMI-INFINITE MODERATOR BLOCK. PART II. EFFECT OF TRAPPED AND COLD NEUTRONS. Grover, P. S.; Kothari, L. S. Nucl. Sci. Eng., 23: 167-9(Oct. 1965).

In a semi-infinite block of beryllium at room temperature, the effect of "trapper" and cold neutrons on the asymptotic equilibrium neutron flux distribution and on diffusion length is investigated by considering various forms for the energy dependence of the transport cross section. It is found that in static experiments, cold neutrons play a dominant role. The effect of non-1/v absorbers on the above properties was also studied. (auth)

43258 NEUTRON DIFFUSION THEORY. Stewart, J. D. (Atomic Energy of Canada Ltd., Chalk River). Nucl. Sci. Eng., 23: 190-2(Oct. 1965).

Some known facts are recalled about neutron diffusion theory in a homogeneous medium and some new facts are pointed out. The central ideas are Fick's law and the assumption of a direct contribution of the sources to the corresponding neutron current. It is assumed that the homogeneous medium extends to infinity, that the neutrons are monoenergetic, and that the scattering and sources are isotropic. (J.F.P.)

43259 THE ENERGY-DEPENDENT TOTAL NEUTRON CROSS SECTION OF POLYETHYLENE. Armstrong, S. B. (Knolls Atomic Power Lab., Schenectady, N. Y.). Nucl. Sci. Eng., 23: 192-4(Oct. 1965). (TID-21436).

The energy-dependent total neutron cross section of polyethylene was measured with a slow-neutron chopper using time-of-flight analysis. The measured total cross section was compared with cross sections that had been calculated using two polyethylene scattering models. In addition, a comparison of the average proton energy calculated using these scattering models was made with the value inferred from the experimental data. Four different types of polyethylene were measured in this experiment. A reactor thermal column served as a source of neutrons. The measured cross sections for all the samples were summed to obtain the total polyethylene cross section which is shown. It was found that the polyethylene model, which is better based on theory, is in poorer agreement with the experiment, thus indicating that further investigation of polyethylene models seems desirable. Also, the degree of crystallinity of polyethylene was found to have little or no influence on the measured total neutron cross section. (J.F.P.)

43260 EFFECT OF BRAGG CUTOFF ON THE DIFFUSION OF THERMAL NEUTRONS IN GRAPHITE. Ahmed, Feroz (Univ. of Delhi). Nucl. Sci. Eng., 23: 203-5(Oct. 1965).

The diffusion of thermal neutrons in semi-infinite slabs of graphite with an infinite plane source of neutrons at the free end of the slab was studied in a range of neutron energies. The effect of change of absorption of the medium on the asymptotic value of the ratio of the total neutron flux below the Bragg cutoff to the total neutron flux above the Bragg cutoff was also studied. The scattering kernel was calculated in the incoherent approximation using the model of lattice vibrations in graphite previously proposed. In the energy region above the Bragg cutoff, the contribution from elastic scattering processes to the transport cross section was calculated for graphite temperatures of 300, 200, and 150°K. These calculations were also made in the energy region below the Bragg cutoff. The value of the ratio of the total neutron flux is plotted as a function of distance from the source plane for graphite temperatures of 300, 200, and 150°K. (J.F.P.)

43261 PORTABLE SMALL-DIMENSION NEUTRON GENERATOR FOR ACTIVATION ANALYSIS. Pastor, E.; Klopfer, E. (Central Inst. of Physics, Budapest). Pribory i Tekhn. Eksperim., No. 4, 36-8(July-Aug. 1965). (In Russian).

A small dimension neutron generator designed for activation analysis was described. The apparatus consists of two blocks: voltage source and accelerator. The accelerating voltage was 120 kv, the ion current was approximately 1 mamp, and the maximum neutron yield was 10^{10} sec^{-1}. (tr-auth)

43262 INELASTIC SCATTERING OF NEUTRONS. VOL. I. Proceedings Series. Proceedings of the Symposium Held at Bombay, 15-19 December 1964. (International Atomic Energy Agency, Vienna). Apr. 1965. 470p. (CONF-804(Vol.I)). IAEA $9.50; S 199.50; £2.17.0; F.Fr. 38,-; DM 33, 25 cy. (STI/PUB/92(Vol.I)).

Thirty-three papers are included; 30 are in English, 1 in French, and 2 in Russian. Separate abstracts have been prepared for 18. Fifteen of the papers were previously abstracted in NSA, 19: 9659, 10478, 11766, 11767, 11768, 11769, 11770, 11863, 12476, 12477, 14077, 14079, 18463, 20553, and 29467. (T.F.H.)

For abstracts of individual papers see: 42889-42894, 43263-43267, and 43480-43486.

43263 INTERPRETATION OF SLOW NEUTRON SCATTERING DATA IN METALS. Sjoelander, A. (Chalmers Univ. of Tech., Gothenburg, Sweden); Johnson, R. pp 61-76 of STI/PUB/92(Vol.I).

The slow neutron scattering technique yields detailed information on phonon dispersion curves in single crystals. This calls for a proper interpretation of the experimental data. The theoretical calculations are normally based on Born-von Kármán's theory for lattice vibrations and it has been shown that also in metals the interatomic interaction extends over a fairly large distance in contrast to what was assumed earlier. Computations demonstrate that the deformation of the electron density within the ions plays an essential role for the lattice vibrations. Similarly

the polarization of the conduction electrons gives rise to the Kohn effect. It is shown that a slight modification of the Born-von Kármán scheme makes it possible to include the response of the electrons, where only purely harmonic motions in normal metals are used. The force constants are expressed in terms of the electronic properties of the crystal and in this way a direct physical significance is given to the force constants. In this formulation the Cochran model as well as the Kohn effect is easily visualized. It is stressed which physical effects are important for the calculations of phonon spectra. The procedure followed in the derivations is similar to that used by Bardeen and Pines and others when calculating the effective electron-phonon interaction. The periodicity of the lattice is included, however, and no approximations are made concerning the electronic motions. Rigorous definitions of the force constants are thus obtained. The results are analogous to those obtained by Baym but our derivation is more direct and in accordance with the conventional formulations of the theory of lattice vibrations. (auth)

43264 PHONON DISPERSION RELATIONS IN ALKALI METALS. Singh, R. P.; Mani, K. K.; Kelkar, V. M. (Indian Inst. of Tech., Bombay). pp 77-86 of STI/PUB/92(Vol.I).

It is shown that the phonon dispersion curves of sodium in the [100], [110], and [111] symmetry directions can be explained on the basis of a simple model, where only central force constants between nearest and next nearest neighbors are considered. The tangential force constant between the nearest neighbors is much smaller than the radial force constant, while for the next nearest neighbors the radial and tangential force constants are comparable. The calculation is carried out on the basis of the model suggested by de Launay, where it is shown that the conduction electrons exert a volume force for longitudinal modes. The stiffness constant of the electron gas is its bulk modulus, which in de Launay's model is equal to the Cauchy discrepancy $[C_{12}-C_{44}]$ for the cubic crystals. The three force constants α_1, α_3, and α_1' can be determined from the measured elastic constants, and the secular equation can be solved to give the dispersion curves. The dispersion curves have also been obtained using the calculated values of the bulk modulus of the electron gas, after considering not only the exchange and correlation energies but also the Fermi kinetic energy. These also agree fairly well with experiment. The measured elastic constants as well as calculated bulk modulus of the electron gas indicate that the Cauchy relation $C_{12} = C_{44}$ holds good approximately in alkali metals. This result requires that the interaction between the atoms be central in nature in spite of the metallic binding. (auth)

43265 INELASTIC SCATTERING OF NEUTRONS IN CHROMIUM. Moeller, H. B.; Mackintosh, A. R. (Research Establishment Risoe, Roskilde, Denmark). pp 95-7 of STI/PUB/92(Vol.I).

The phonon spectrum of chromium is studied by neutron inelastic scattering. The dispersion curves are very similar in form to those of tungsten and molybdenum, indicating similar interionic force constants. The neutron groups broaden but do not shift appreciably when the temperature is raised. No effect has been observed that can be attributed to the interaction between the phonons and the crystal magnetization in the antiferromagnetic phase. (auth)

43266 THEORETICAL INVESTIGATIONS OF THE INFLUENCE OF ANHARMONICITY AND IMPURITIES ON NEUTRON SCATTERING BY CRYSTALS AND ON THE MOESSBAUER EFFECT. Waller, I. (Uppsala Univ.; Aktiebolaget Atomenergi, Studsvik, Sweden). pp 225-30 of STI/PUB/92(Vol.I).

The effect of diluted substitutional impurities, and the combined effect of impurities and anharmonicity, on the Mössbauer effect and on neutron scattering by crystals are studied. (auth)

43267 A STUDY OF INELASTIC NEUTRON SCATTERING BY ANHARMONIC CRYSTALS WITH THE DAMPING THEORY. Akcasu, A. Z.; Osborn, R. K. (Univ. of Michigan, Ann Arbor). pp 261-84 of STI/PUB/92(Vol.I).

The damping theory is developed in terms of projection operators, and an expression for the transition probability per unit time, suitable to line shape studies in general, is obtained. This expression replaces the usual energy-conserving delta function by a Lorentzian distribution whose width is equal to the difference of the widths of the initial and final states. Using this expression, a formula for the scattering cross-section of slow neutrons by an anharmonic crystal is derived. Expressions for the width and shift of lines corresponding to multiphonon events in general, and to a one-phonon event as a special case, are obtained and investigated in the zero and high temperature limits. It is found that the inverse of phonon lifetime is expressible in terms of the difference of the widths of the crystal states. In the high temperature limit, the formula predicts a quadratic temperature dependence. This result is discussed in terms of the concept of phonon lifetime. (auth)

43268 NEUTRON WAVE PARAMETERS IN MONOENERGETIC TRANSPORT THEORY. Travelli, A. (Massachusetts Inst. of Tech., Cambridge). 6p. (CONF-650602-56). Gmelin, AED-CONF-65-125-62.

From American Nuclear Society, 11th Annual Meeting, Gatlinburg, Tenn.

Neutron wave parameters, the attenuation and the phase constants for a pulsed neutron source and a homogeneous moderator, are calculated in monoenergetic transport theory with linearly anisotropic scattering. Comparison is made with results of monoenergetic diffusion theory, monoenergetic P-1 theory, multienergetic diffusion theory and some experimental results for graphite. (L.B.S.)

Nuclear Properties and Reactions

Refer also to abstracts 42745, 42789, and 43110.

43269 (GEMP-360) GAMMA RAY PRODUCTION CROSS SECTIONS (SUPPLEMENT NO. 1). Edwards, W. E. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). Aug. 26, 1965. Contract AT(40-1)-2847. 47p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

Gamma ray production cross sections are presented as a function of 15 neutron lethargy groups and 11 photon energy groups for 15 elements and isotopes. They were computed by Program GAMMA-P and account for the production of gamma rays by neutron radiative capture, neutron inelastic scattering, neutron induced fissioning, and (n,α) reactions. (auth)

43270 (IA-1007) CALCULATION OF THE ENERGY SPECTRUM OF FISSION NEUTRONS. Nebenzahl, I.; Rakavy, G. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Jan. 1965. 26p. Dep. mn.

A method for calculating fission neutron spectra is described step by step, along with the principal difficulties and the necessary postulates. The mathematical complexity of the problem is found to depend strongly on the physical assumptions about the variation of nuclear temperature with excitation. Approximate formulas and results are given for models which handle this variation schematically. Calculations were performed for thermal ^{235}U fission, and agreement with the experimental spectrum was obtained. (auth)

43271 (JINR-P-2198) POISKI ZAVISIMOSTI DOPPLEROVSKOGO USHIRENIYA NEITRONNYKH REZONANSOV OT KHIMICHISKOI SVAYAZI. REZONANS 405 ev Cl^{35}. (Search for Dependence of Doppler Broadening of Neutron Resonances on Chemical Binding. The 405 ev Resonance for ^{35}Cl). Karzhavina, E. N.; Popov, A. B.; Sheltontsev, I. I.; Yazvitskii, Yu. C. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1965. 14p. Dep. mn.

Using a neutron spectrometer the curves of transmis-

sion and self-indication were measured for NaCl samples of several thicknesses. These data were employed to estimate the values $g\Gamma_n$ and Γ for the 405 ev resonance for ^{35}Cl which were found to be 0.037 ± 0.002 and 0.82 ± 0.09 ev, respectively. The curves of transmission for the samples NaCl, CCl_4, $PbCl_2$ with the same thicknesses for ^{35}Cl were also measured at the temperature of 300 and 80°K. The areas of the 405 ev resonance for ^{35}Cl obtained with NaCl CCl_4, $PbCl_2$ at T = 300°K and with the sample CCl_4 at T = 300°K were equal in the limits of experimental accuracy (~1.5%). The cooling of the NaCl sample from 300 to 80°K led to the area reduction by 10%. (auth)

43272 (JINR-P-2218) REAKTSII (p,pn), (p,2n) I (p,n) NA ^{89}Y POD DEISTVIEM PROTONOV VYSOKIKH ENERGII. (Reactions (p,pn), (p,2n) and (p,n) on ^{89}Y Induced by High Energy Protons). Wang, Chen-peng; Levenberg, I.; Pokrovskii, V.; Tarasova, L.; Yutlandov, I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1965. 13p. Dep. mn.

The reactions (p,pn), (p,2n) and (p,n) on ^{89}Y were investigated in the proton energy range of 120–670 Mev. The cross sections of these reactions are decreased with proton energy from 95.5, 15.0, and 5.8 mb at 120 Mev down to 62.0, 3.1, and 1.5 mb at 670 Mev, respectively. The dependence of the ratio $\sigma_{p,2n}/\sigma_{p,n}$ on the mass number of the target nucleus and proton energy is discussed. (auth)

43273 (JINR-P-2238) DVOINAYA PEREZARYADKA π-MEZONOV NA YADRAKH Bi, C, Al, I Pb. (Double Charge Exchange of Pions on Be, C, Al, and Pb Nuclei). Batusov, Yu. A.; Bunyatov, S. A.; Sidorov, V. M.; Yarba, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1965. 8p. Dep. mn.

The total cross sections of double 80 Mev π^+ meson charge exchange on Be, Al and Pb nuclei and 140 Mev π^- mesons on Be, C and Pb nuclei were measured. (auth)

43274 (JINR-P-2279) VZAIMODEISTVIE ELEMENTARNYKH CHASTITS S ATOMNYMI YADRAMI V OBLASTI ENERGII 1-30 Gev. (Interaction of Elementary Particles With Atomic Nuclei in the Energy Region 1-30 Gev). Artykov, I. Z.; Barshenkov, V. S.; Eliseev, S. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1965. 10p. Dep. mn.

The results are given of statistical calculations of proton interactions with energies 6.2, 9.17, and 25 Bev with emulsion nuclei. The calculations are made in the framework of cascade-evaporation model. Special emphasis is laid upon the interactions involving a group of heavy nuclei. The results of calculations are in good agreement with experimental data. (auth)

43275 (LA-3315) THE APPROXIMATE DOPPLER BROADENING OF AN ISOLATED NUCLEAR RESONANCE Devaney, Joseph J. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Mar. 1965. Contract W-7405-eng-36. 39p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

The narrow, isolated nuclear resonance cross sections of an isotope are broadened by thermal motion of the target nuclei. A few approximate formulas are given for calculating such broadening. (D.L.C.)

43276 (NAA-SR-Memo-11456) OPTICAL MODEL ANALYSIS OF NEUTRONS SCATTERED FROM NONSPHERICAL NUCLEI. Dunford, C. L.; Reynolds, J. T.; Fenech, H. (Atomics International, Canoga Park, Calif.). July 29, 1965. Contract AT(11-1)-Gen-8. 18p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

An analysis of the scattering of neutrons from a number of nuclei was performed using a nonspherical optical model first proposed by Chase et al. The optical model includes a spin-orbit interaction, a real well, and a surface-imaginary well. Particular emphasis is placed in the region of a few Mev where experimental data for both elastic and inelastic angular distributions exist. A Hauser-Feshbach calculation was incorporated to account for compound nucleus scattering which is important in this energy region. The theoretical calculations of elastic and inelastic angular distributions for heavy rotor nuclei (Th-232 and U-238) compare favorably with experimental data. The deformation parameters, β, are in good agreement with values measured by Coulomb excitation techniques. Some discrepancies exist due to inadequacies of this nonspherical model for lighter elements (Fe, Ti). (auth)

43277 (NP-15208) ON THE STABILITY OF THE HYPERNUCLEUS $_{\Lambda}He^6$. Bulletin No. 20. Willain, C. (Brussels Univ. (Belgium)). May 1965. 19p. Dep. mn.

In the present work, the result of an analysis of the $_{\Lambda}He^6$ hypernucleus in a three-body model alpha-neutron-hyperon (Λ^0) is reported. This analysis is carried out by a variational calculation using a trial radial wave function with three variational parameters. The best potentials to describe $_{\Lambda}He^6$ are considered to be a Yukawa Λ-nucleon potential; an exponential potential; and the α–n potential used in the phase-shift analysis of ρ–α scattering data. The result of a variational calculation using those hypotheses is that the $_{\Lambda}He^6$ hypernucleus is not bound. (auth)

43278 (NP-15358) NUCLEAR STRUCTURE STUDIES OF PHOSPHOROUS ISOTOPES. II. THE $^{28}Si(d,n)^{29}P$ REACTION. Davies, W. G.; Dawson, W. K.; Neilson, G. C.; Ramavataram, K. (Alberta Univ., Edmonton. Nuclear Research Centre). [1964]. 27p. Dep. mn.

Angular distributions of the neutrons leading to states of ^{29}P up to an excitation of 3.5 Mev were obtained using the $^{28}Si(d,n)^{29}P$ reaction for deuteron energies of 4 and 5 Mev. The angular distributions for the ground, first and second excited states of ^{29}P were analyzed using the distorted wave Born approximation. The experimental spectroscopic factors favor a Nilsson model description for the ^{29}P nucleus. Evidence for spin dependent structure was seen in the angular distributions of neutrons leading to the 1.38-Mev($J^\pi = 3/2^+$) and 1.96-Mev($J^\pi = 5/2^+$) states of ^{29}P. Thus it appears that the general spin dependent features seen for the angular distributions of the protons in (d,p) reactions are also seen in (d,n) reactions. (auth)

43279 (NP-15383) MNOZHESTVENNOE ROZHDENIE π^0-MEZONOV NA YADRAKH KSENONA. (Multiple π^0 Production on Xenon Nuclei). Report No. 220. Grashin, A. F.; Demidov, V. S.; Kirillov-Ugryumov, V. G.; Ponosov, A. K.; Prokhorova, L. A.; Sergeev, F. M.; Shalamov, Ya. Ya. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1964. 15p. Dep. mn.

The multiple π^0 production (two and more in the act of interaction) by 2.8 Bev/c π^- mesons on Xe nuclei was investigated. The cross section for such a process (summed over any other reaction products) was estimated: $\sigma \sim 35$ mb. Experimental data indicate more cumbersome reaction mechanism compared with collisions of pions and quasifree nucleons of nuclei. (auth)

43280 THEORETICAL TOTAL CROSS SECTIONS FOR HIGH ENERGY NUCLEAR FIELD PAIR PRODUCTION IN LIGHT ELEMENTS. Soerenssen, Aimar (CERN, Geneva). Arkiv Fys. Seminar Trondheim, No. 6, 20p.(1965).

Total cross sections for pair production in a screened nuclear field are tabulated for H, He, B, N, O, F, Ne, Na, Mg, Si, P, S, and Cl. The cross sections were calculated using Hartree-Fock-Slater atomic form factors; the Coulomb correction was taken into account. Cross sections obtained with Thomas-Fermi-Moliere form factors are included for comparison, together with cross sections based on the assumption of no screening. (D.C.W.)

43281 INVESTIGATION OF THE MATRIX ELEMENTS IN La-140. Subotowicz, M. At. Kozlemen., 7: 3-28 (Mar. 1965).

Measurements are reported in connection with the energy dependence of the angular correlation for the outer group of the electrons in La-140 and the γ-transition (E = 160 Mev) of Ce-140 in the electron energy range from 160 to 2.05 Mev. After the necessary corrections the values of the asymmetry coefficient A_2 in the correlation function $N(W,\vartheta) = 1 + A_2P_2(\cos\vartheta)$ were found. From a set of parameters calculated, the nuclear matrix elements contributing to the investigated transition were calculated.

Also on the basis of these matrix elements the application of different nuclear models is analyzed. The results support the supposition that the configuration of neutrons and protons in La-140 is $(2f_{5/2})_n$ and $(1g_{9/2})_p$. The theory of the bare nucleon and CVC hypothesis was tested using a defined parameter. (J.F.P.)

43282 NUCLEAR ENERGY. WHAT IT IS AND HOW IT ACTS. Kramer, Andrew W. Atomics, 18: 49-52(July-Aug. 1965).

Reasoning that led to the concept of the collective model of the nucleus is presented. Physical aspects of the collective model are discussed. The problem of quadrupole moments is considered. (M.C.G.)

43283 THE REACTIONS ^{6}Li(γ,d) AND ^{7}Li(γ,t) BELOW 4 Mev. Dallimore, P. J.; Lam, K. S.; Thies, H. H. (Oxford Univ.). Australian J. Phys., 18: 389-92(Aug. 1965).

The reactions ^{6}Li(γ,d) and ^{7}Li(γ,t) were investigated with bremsstrahlung from a linear accelerator by detecting the charged reaction products in coincidence with solid-state surface barrier detectors. The purpose was to confirm with bremsstrahlung the extreme weakness of these reactions below 4 Mev. The investigation of Li(γ,t) is of particular interest also for the reason that the energy at which photodisintegration becomes possible energetically is usually slightly less than the energy of the first virtual state. It is of interest to know whether photodisintegration occurs at this state or at some intermediate value. A linear accelerator was used for these reactions. The target consisted of lithium hydroxide films supported by thin carbon backings. The results for both reactions confirm the extreme weakness of the reactions below 4.1 Mev. The result for ^{7}Li(γ,t) shows that an empirical photonuclear threshold need not coincide with the energy at which the corresponding reaction becomes energetically possible. (J.F.P.)

43284 CRITICAL TEMPERATURE OF NUCLEAR MATTER. Khanna, K. M. (Indian Inst. of Tech., Kharagpur, India). Indian J. Pure Appl. Phys., 3: 262-3 (July 1965).

The critical temperature of transition of a nuclear system consisting of equal number of protons and neutrons was calculated assuming for the atomic nucleus an α-particle structure and by using the De Boer's principle of corresponding states. The basic interaction between nucleons was assumed to be of the same type as that of the experimentally fitted two-body potential proposed by Gammel and Thaler (Phys. Rev., 107: 291(1957)). The value of the critical temperature evaluated by this method (5 Mev) agrees well with the values reported in literature. (auth)

43285 ISOTOPE EFFECT OF NUCLEAR MAGNETIC RESONANCES IN METALLIC MERCURY. Blumberg, W. E.; Eisinger, J.; Shulman, R. G. (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Phys. Chem. Solids, 26: 1187-94(Aug. 1965).

Accurate measurements of the nuclear magnetic resonances of ^{199}Hg and ^{201}Hg in metallic mercury are reported. The Knight shifts were (2.724 ± 0.005) and (2.722 ± 0.005)%, respectively. From these measurements the hyperfine structure anomaly of these nuclei was shown to be very small, i.e. (0.07 ± 0.11)%. The experimental techniques required to measure the resonance positions accurately are discussed. Corrections for the effects of mode mixing and integrating time constant were developed. An analysis was made of the influence of hyperfine, quadrupole, and exchange effects on the resonance line. (auth)

43286 GAMMA-GAMMA ANGULAR CORRELATIONS IN Cs^{131}. Hirose, Tachisige; Hisatake, Kazuo (Tokyo Inst. of Tech.). J. Phys. Soc. Japan, 20: 1104-7(July 1965).

The γ-γ angular correlation was remeasured for the 924-124 kev cascade in ^{131}Cs, since the correlation function obtained in the previous experiment was found to contain error due to Compton scattered gamma rays. In the experiment these gamma rays were made to be negligibly small by use of lead collimators and absorbers. The revised correlation function has been obtained to be $W_{924-124}(\theta) = 1 - (0.056 \pm 0.014)\,P_2(\cos\theta) - (0.026 \pm 0.028)\,P_4(\cos\theta)$, where the errors are statistical ones only. The possibility of spin assignment of ½ for the 124 kev level is probably excluded. The γ-γ angular correlation for the 832-216 kev cascade was also measured with the same geometry. The correlation function is obtained to be $W_{832-216}(\theta) = 1 - (0.185 \pm 0.025)\,P_2(\cos\theta) + (0.049 \pm 0.029)\,P_4(\cos\theta)$. The E2/M1 mixing ratios for the 832 kev and 924 kev transitions are discussed. (auth)

43287 CROSS SECTION FOR THE ABSORPTION OF γ QUANTA BY OXYGEN NUCLEI IN THE ENERGY INTERVAL 13.5-22 Mev. Dolbilkin, B. S.; Korin, V. I.; Lazareva, L. E.; Nikolaev, F. A. (Lebedev Inst. of Physics, Moscow). JETP Letters (USSSR) (English Transl.), 1: 148-51(June 1, 1965).

The results of measurements of the cross section for the absorption of gamma quanta by ^{16}O nuclei at 13.5 to 22 Mev are presented. Four resonances were observed below 21.5 Mev. (D.C.W.)

43288 INVESTIGATION OF THE REACTIONS P(n,γ) ^{32}P AND ^{32}S(n,γ)^{33}S. Van Middelkoop, G.; Spilling, P. (Rijksuniversiteit, Utrecht). Nucl. Phys., 72: 1-22 (1965).

The γ radiation following capture of thermal neutrons in ^{31}P and ^{32}S was investigated with scintillation-spectrometer techniques. Measurements of single and coincidence spectra and of γ-γ angular correlations yield the following spins in ^{32}P: J(0.52) = 0, J(1.32) = (2), J(4.04) = 1, J(4.88) = 1, J(5.35) = 2, and J(5.78) = 1. The spins of the 1.15 and 3.26 Mev levels are confirmed to be 1 and 2, respectively. The γ-ray decay of some lower levels is determined. In the ^{33}S nucleus a 1.44-7.20 Mev cascade is detected. The spin and parity of the intermediate level are $^3/_2{}^+$ or $^5/_2{}^+$. However, the existence of a level at about 1.4 Mev, expected on basis of a shell-model calculation, can not be proved. In a sum-coincidence measurement a few other two-step cascades are detected. (auth)

43289 THE PHOTODISINTEGRATION OF ^{28}Si. Cannington, P. H.; Stewart, R. J. J.; Hogg, G. R.; Lokan, K. H.; Sargood, D. G. (Univ. of Melbourne). Nucl. Phys., 72: 23-32(1965).

Energy spectra from the reactions ^{28}Si(γ,p)^{27}Al and ^{28}Si(γ, α)^{24}Mg were measured with good resolution (≈70 kev) by irradiating a silicon surface barrier detector with bremsstrahlung at a number of energies between 16.2 and 23.2 Mev. The partial cross sections, ^{28}Si(γ,α_0)^{24}Mg and ^{28}Si(γ, p_0)^{27}Al, were determined absolutely throughout this energy range, together with the proton branching ratios to the first two excited states of ^{27}Al for each of the major states observed in ^{28}Si. The results are compared with current particle-hole calculations. (auth)

43290 THE SEMI-EMPIRICAL MASS FORMULA AND THE SUPERFLUID MODEL OF NUCLEI. Bauer, M. (Universidad Nacional Autonoma de Mexico, Mexico City); Canuto, V. Nucl. Phys., 72: 33-48(1965).

It is shown how, by suitable rearrangement, the ground state energy of a superfluid nucleus, as given by Belyaev, can reproduce the semi-empirical mass formula of Bethe-Weizsäcker. The coefficients are not constant but depend on the deformation, being larger for deformed nuclei. (auth)

43291 INVESTIGATION OF THE (d,p) REACTION ON ^{31}P IN THE DEUTERON ENERGY RANGE 1.3-2.5 Mev. Baranik, A. T.; Abuzeid, M. A.; El-Zaiki, M. I.; Zaloubovsky, I. I. (Atomic Energy Establishment, Cairo). Nucl. Phys., 72: 49-62(1965).

Excitation functions of several proton groups (p_0, p_1, p_2, p_3, p_4, p_5, $p_{7,8}$, $p_{9,10}$) resulting from the reaction ^{31}P (d,p) ^{32}P were measured at angles of 30 and 150°. The total and differential cross sections are given. The excitation functions for all groups indicate a number of resonances which exhibit fluctuations in the range of 25 to 100 kev. Many of the observed resonances are uncorrelated at 30 and 150°. There is also no correlation between groups leading to different states of a residual nucleus.

Proton angular distributions were measured for six energies of incident deuterons. Some of the angular distributions typical for the direct interaction are compared with those from the stripping formula with regard to nuclear deformation. The value of the deformation calculated from the angular distributions gives a nuclear magnetic moment close to the experimental value. (auth)

43292 THE 4.431 Mev EXCITED STATE OF ^{23}Na. Barber, W. C.; Vanpraet, G. J. (Stanford Univ., Calif.). Nucl. Phys., 72: 63-7(1965).

The 4.431-Mev nuclear excitation in ^{23}Na was observed by measuring the electron energy spectrum resulting from inelastic scattering of 58.5-Mev primary electrons through an angle of 180°. It is shown that this excitation is most likely due to a magnetic dipole transition. The integrated inelastic electron scattering cross section for this level was found to be $(0.48 \pm 0.05) \cdot 10^{-2}$ μb/sterad. (auth)

43293 CORE EXCITATION IN ^{18}O. Engeland, T. (Univ. of Oslo). Nucl. Phys., 72: 68-96(1965).

The low-lying even-parity energy levels of ^{18}O are calculated within the shell model. Core excitations from the double closed ^{16}O system are taken explicitly into account using the SU_3 coupling scheme. The resulting energy spectrum shows nice agreement with experiments for nearly all states below 6 Mev excitation energy. The branching ratio for the E2 transitions from the first 2^+ (1.98 Mev) to the ground state and from the second 0^+ (3.63 Mev) to the first 2^+ are well described in the calculation even if the absolute values are somewhat too small. (auth)

43294 PHASE VARIATION IN THE SCATTERING OF ALPHA PARTICLES BY ^{58,62}Ni. Horen, Daniel J. (Naval Radiological Defense Lab., San Francisco); Meriwether, John R.; Harvey, Bernard G.; Bussiere de Nercy, A.; Mahoney, Jeannette. Nucl. Phys., 72: 97-105(1965). (UCRL-11904).

The scattering of various energy alpha particles by ^{58}Ni and ^{62}Ni was studied. It was found that the phase of the inelastic groups relative to that of the elastic group tends to vary with energy, the most pronounced variation being that arising from excitation of the first 4^+ (two-phonon) level. The data are compared with the modified diffraction model of Austern and Blair. The theory is highly successful in fitting the data for excitation of the first 2^+ and 3^- levels. The variation in phase of the 4^+ angular distribution with energy could be reasonably reproduced by considering an admixture of one and two phonon excitations. Nuclear matrix elements and reduced electric transition probabilities for some of the levels in ^{58}Ni and ^{62}Ni are induced and, for the first 2^+ and 3^- levels, are found to be independent of the energy of the incident alpha particles. (auth)

43295 BETA DECAY OF ^{86}Rb. Thompson, Richard H.; Casper, Karl J. (Western Reserve Univ., Cleveland). Nucl. Phys., 72: 106-12(1965).

The beta decay of ^{86}Rb was measured using lithium drifted surface barrier silicon detectors. Corrections to the spectrum were made using the measured response function of the detectors. The inner branch has an allowed spectral shape and an endpoint energy of 677 ± 5 kev, and the outer branch has a first forbidden unique spectral shape and an endpoint energy of 1753 ± 4.5 kev. (auth)

43296 NEW DATA ON THE ^{188}Re DECAY SCHEME. Dzelepow, B. S.; (Mendeleyev Metrology Inst., Leningrad); Vitman, V. D.; Volnova, N. A. Nucl. Phys., 72: 132-6(1965).

The energies and relative intensities of ^{188}Re γ lines were determined with a magnetic γ-spectrometer elotron. Metallic rhenium activated by thermal neutrons was used as the source. Altogether 23 γ lines were observed in the spectrum, including the lines with energies 717, 1019, 1175, 1193, 1322, 1460, 1656, 1675, 1852, 1869, and 2026 kev detected for the first time. A ^{188}Re decay scheme is considered with three new levels at 2026, 1828, and 1809 kev. The quantum characteristics of these levels are discussed. The intensities of β transitions to the ^{188}Os levels are determined from the balance of γ-transition intensities. (auth)

43297 NUCLEAR GAMMA ABSORPTION CROSS SECTION FOR MAGNESIUM IN THE ENERGY REGION 10-30 Mev. Dolbilkin, B. S.; Korin, V. I.; Lazareva, L. E.; Nikolaev, F. A.; Zapevalov, V. A. (Lebedev Inst. of Physics, Moscow). Nucl. Phys., 72: 137-44(1965).

The absorption cross section of γ quanta by Mg nuclei in the energy range 11 to 30 Mev was measured by the absorption method on a 260-Mev synchrotron. A nine channel pair magnetic γ spectrometer was used as a detector. The cross section obtained has a resonance structure and can be represented as a superposition of several partially overlapping peaks. Comparison with the resonances observed in the partial reaction cross sections shows that these peaks are probably separate groups of unresolved transitions. The shape and integrated cross section of the experimental curve in the 11 to 30 Mev range do not agree with the results of the available theoretical calculations for Mg. (auth)

43298 FERMI TO GAMOW-TELLER MATRIX ELEMENT RATIOS IN ALLOWED BETA TRANSITIONS IN ^{152}Eu, ^{124}Sb AND ^{72}Ga. Bhattacherjee, S. K.; Mitra, S. K.; Padhi, H. C. (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys., 72: 145-57(1965).

The circular polarization of gamma radiation following allowed beta decays of the type $3^- \xrightarrow{\beta} 3^-$ was measured in three complex nuclei. The polarimeter employed the forward Compton scattering of gamma rays. The performance of the polarimeter was checked by measuring the known beta circularly polarized gamma correlation in ^{60}Co and ^{22}Na. The measured asymmetry parameter A and the isobaric spin impurity coefficient α which account for the Fermi component in the mixed decays are given. (auth)

43299 PHOTONUCLEAR STUDY OF THE ISOMERIC RATIO IN ^{39}K, ^{90}Zr AND ^{91}Mo ABOVE THE GIANT RESONANCE. Costa, S. (Universita, Turin); Ferrero, F.; Ferroni, S.; Pasqualini, L.; Silva, E. Nucl. Phys., 72: 158-66(1965).

The relative probability of forming each state of isomeric pairs by means of (γ,n) reactions was measured in ^{39}K, ^{90}Zr, and ^{92}Mo with photon energy ranging from threshold to 70 Mev. The results indicate that above the giant resonance, the 0^+ and 3^+ states of ^{38}K have nearly the same formation cross section, while the $\frac{9}{2}^+$ states of ^{89}Zr and ^{91}Mo are formed with negligibly small probability. An attempt was made to deduce from these results the value of the dispersion parameter of the spin-dependent level density formula. (auth)

43300 THE (d,p) REACTION ON ^{23}Na IN THE DEUTERON ENERGY RANGE FROM 1.0 TO 2.5 Mev. El-Behay, A. Z.; Farouk, M. A.; Jhingan, M. L.; Nassef, M. H.; Zaloubovsky, I. I. (Atomic Energy Establishment, Cairo). Nucl. Phys., 72: 167-76(1965).

Excitation functions and angular distributions of eight proton groups from the ^{23}Na(d,p)^{24}Na reaction leading to levels of ^{24}Na with excitation energy up to 3.41 Mev were measured. The total and differential cross sections are given. The measured excitation functions show broad maxima at various deuteron energies, which indicate contribution from the compound-nucleus mechanism. Angular distributions show a stripping pattern, predominantly at deuteron energies higher than 2.0 Mev. (auth)

43301 MONOPOLE EXCITATIONS AND ELASTIC SCATTERING. Ravenhall, D. G. (Univ. of Illinois, Urbana); Yennie, D. R.; Clark, B. C.; Herman, R. Nucl. Phys., 72: 177-86(1965).

A simple relation between elastic scattering amplitudes and monopole excitation amplitudes is pointed out and illustrated. It applies to potential scattering and can be used for the nucleon–nucleon problem as well as electron–nucleus scattering. The example of scattering of electrons by carbon and calcium is used to illustrate the method. (auth)

43302 PROPERTIES OF SOME NUCLEAR MASS DIFFERENCES. Gupta, S. C. (Australian National Univ., Canberra). Nucl. Phys., 72: 187-93(1965).

Second and fourth order mass differences, symmetrical in N and Z, are calculated and plotted. Besides other properties, these differences show a clear separation of odd-mass and even-mass values, which can be understood if there is an extra pairing term for odd nuclei in the semi-empirical mass formula. (auth)

43303 Q VALUES OF INVERSE REACTIONS INVOLVING ALPHA PARTICLES. Browne, C. P.; Dorenbusch, W. E.; O'Donnell, F. H. (Univ. of Notre Dame, Ind.). Nucl. Phys., 72: 194-208(1965).

Precision Q-value measurements were made on three pairs of inverse reactions involving alpha particles. Errors arising from charge change and high energy loss of alpha particles were thus investigsted. The mass differences obtained are compared with mass spectrometer values, other Q-value measurements, and a compilation of atomic masses. The Q values obtained (in Mev) are: $^{24}Mg(\alpha,p)^{27}Al$, -1.5989 ± 0.0010; $^{27}Al(p,\alpha)^{24}Mg$, 1.5984 ± 0.0010; $^{10}B(\alpha,d)^{12}C$, 1.3406 ± 0.0015; $^{12}C(d,\alpha)^{10}B$, -1.3401 ± 0.0012; $^{6}Li(\alpha,p)^{9}Be$, -2.1256 ± 0.0012; $^{9}Be(p,\alpha)^{6}Li$, 2.1254 ± 0.0018. The energy scale is based on a ^{210}Po alpha particle energy of 5.3045 Mev. Errors may be considered as standard deviations but include estimates of systematic errors. They do not include the uncertainty (±0.5 kev) in the calibration energy. No experimental discrepancy arising from the use of alpha particles was found. No charge change effects were observed. Mass spectrometer values and the mass compilation values agree with these results within the respective uncertainties. These measurements provide the most accurate mass differences yet given for the atoms involved. (auth)

43304 ANGULAR DISTRIBUTION FOR THE $^{32}S(n,\alpha_0)^{29}Si$ GROUND STATE REACTION. Gonzalez, L.; Rapaport, J. (Universidad de Chile, Santiago). Nucl. Phys., 72: 218-24(1965).

The differential cross section for the $^{32}S(n,\alpha_0)^{29}Si$ reaction was measured for an incident neutron energy of 3.60 Mev. Experimental points were taken with a solid state detector every 20° between 0 and 114° lab system. A Hauser-Feshbach type of calculation was made for this reaction, assuming compound-nucleus formation. The experimental points agree with the shape of the theoretical curve. The estimated experimental differential cross section at 0° is 20 ± 8 mb/sterad. (auth)

43305 THE $D(^3He,pn)^3He$, $D(^3He,2p)T$ AND $^3He(^3He,2p)^4He$ REACTIONS. Zurmuehle, R. W. (Univ. of Pennsylvania, Philadelphia). Nucl. Phys., 72: 225-35(1965).

The $D(^3He,pn)^3He$, $D(^3He,2p)T$, and $^3He(^3He,2p)^4He$ reactions were studied at several angles by observing two of the three final particles in coincidence and analyzing their energies with a two-parameter pulse-height analyzer. The $D(^3He,pn)^3He$ reaction was found to proceed through ^3He-n and $p-n$ final state interactions. The $D(^3He,2p)T$ proceeds predominantly through excited states of ^4He. No evidence was found for a strong $p-p$ final state interaction. The quantum numbers for the second excited state of ^4He are suggested as $1^-(T = 1)$. The $^3He(^3He,2p)^4He$ reaction proceeds predominantly through the ground state and first excited states of ^5Li. Again, no evidence was found for a strong $p-p$ final state interaction. (auth)

43306 NUCLEAR STATES OF ^{149}Pm. Nieschmidt, E. B.; Potnis, V. R.; Ellsworth, L. D.; Mandeville, C. E. (Kansas State Univ., Manhattan). Nucl. Phys., 72: 236-40(1965).

The 1.8-hr ^{149}Nd was produced when Nd_2O_3, isotopically concentrated in ^{148}Nd, was irradiated for 2 hr in a reactor. The gamma ray spectrum was observed with a Ge(Li) detector. Gamma rays decaying with the 1.8-hr half life were measured at energies of 60, 76, 97, 114, 154, 187, 197, 210, 226, 240, 267, 309, 324, 348, 423, 443, 542, 556, and 655 kev. These data, along with gamma-gamma and beta-gamma coincidence studies of earlier investigations, were employed to prepare a level diagram for ^{149}Pm. (auth)

43307 EFFECTIVE INTERACTIONS FOR THE 1p SHELL. Cohen, S.; Kurath, D. (Argonne National Lab., Ill.). Nucl. Phys., 73: 1-24(1965).

Effective interactions for the 1p shell are obtained by fitting energy data about nuclear levels. Magnetic dipole moments and probabilities for M1 gamma transitions and beta decay are calculated with the resultant wave functions. Comparison of such quantities with experiment provides an important check on the validity of the picture. The properties of the interaction are compared with those found in an earlier calculation and are also compared with the interaction deduced from nucleon-nucleon scattering. For consistency with the scattering potential, a term proportional to $(\sigma_1 \cdot 1)(\sigma_2 \cdot 1)$ as was introduced by Hamada and Johnston must be included. (auth)

43308 THE $^{40}Ca(^3He,\alpha)^{39}Ca$ AND THE $^{40}Ca(^3He,^3He)^{40}Ca$ REACTIONS BETWEEN 8.00 Mev AND 10.25 Mev. Cline, D.; Alford, W. Parker; Blau, L. M. (Univ. of Rochester, N. Y.). Nucl. Phys., 73: 33-48(1965). (UR-875-74).

Angular distributions were measured for the $^{40}Ca(^3He,\alpha)^{39}Ca$ reaction leading to the ground and first three excited states of ^{39}Ca. The ground state reaction was studied at laboratory energies of 8.00, 8.50, 9.00, 9.50, and 10.00 Mev and over an angular range from 7.5 to 170°. The excited states reaction data were measured at 9.00 Mev over an angular range from 7.5 to 120°. Excitation functions for the α_0 group were also measured at laboratory angles of 45, 60, 75, and 90° over the energy range from 8.00 to 10.25 Mev. The elastic scattering of ^3He from ^{40}Ca was measured at laboratory energies of 8.50 and 9.50 Mev. Excitation functions of the elastic scattering measured at angles of 45, 60, 75, and 90° over the energy range from 8.00 to 10.25 Mev showed essentially the E^{-2} behavior expected for Rutherford scattering. The reaction cross sections were compared with the predictions of a zero range distorted wave (DW) calculation. The DW calculations predicted the shape of the ground state angular distribution very well, assuming it proceeded by pick-up of a d wave neutron. However, the calculated cross section was smaller than the measured cross section by an average factor of 25. The reaction leading to the first excited state of ^{39}Ca at 2.47 Mev was found to proceed by pick-up of an s wave neutron implying that the spin of this state is $\frac{1}{2}^+$. The magnitude of the cross section implies that this state contains 70% of the $2s_{\frac{1}{2}}$ pick-up strength if the calculated cross section is renormalized by the same factor as is required to explain the ground state data. The reaction proceeding to the third excited state of ^{39}Ca at 3.03 Mev is quite weak and might be excited partly through compound nucleus formation. If the reaction to this state is assumed to be a direct pick-up, then the angular distribution can be explained as the pick-up of an $l = 1$ neutron implying either $\frac{1}{2}^-$ or $\frac{3}{2}^-$ for the spin of this state. The magnitude of the cross section indicates either that the ground state of ^{40}Ca must contain configurations of the form $(^{40}Ca)^{-1}_{\frac{3}{2}}(2p)^1_{\frac{3}{2}}$, with a strength of about 0.11, or that this state in ^{39}Ca contains admixtures of $(1p)^{-1}$ configurations with a strength of about 0.10. The magnitude of the cross section for the transition to the second excited state at 2.80 Mev is comparable to that to the first excited state, but the shape of angular distribution is not in agreement with the results of DW calculations for any $l \leqq 3$. (auth)

43309 THE DECAY ENERGIES OF ^{197}Hg AND ^{195}Au. De Wit, S. A.; Wapstra, A. H. (Instituut voor Kernphysisch Onderzoek, Amsterdam). Nucl. Phys., 73: 49-53 (1965).

The electron capture decay energies of ^{197}Hg and ^{195}Au were determined from the fraction K capture in the transition to the 268 kev level in ^{197}Au and that to the 129 kev level in ^{195}Pt, respectively. The total decay energies are $415^{+\frac{11}{13}}$ kev for ^{197}Hg and 227 ± 2 kev for ^{195}Au. (auth)

43310 DIRECT PROCESSES IN THE INELASTIC SCATTERING OF FAST NEUTRONS ON ^{23}Na NUCLEI. Bundschuh, G.; Emendoerfer, D. (Technische Hochschule, Stuttgart). Nucl. Phys., 73: 54-64(1965). (In German).

The contribution of direct processes to inelastic scattering of fast neutrons on ^{23}Na is calculated. The DWBA method is used. The ^{23}Na nucleus is described by the collective model. The interaction potential for direct excitation is the anisotropic part of an axial-symmetric optical potential. The isotropic part contains a spin-orbit coupling. The direct processes contribute 5–10% to the inelastic scattering exciting the first two levels of ^{23}Na. (auth)

43311 MONOPOLAR TRANSITION IN ^{18}O. Gorodetzky, S.; Gallmann, A.; Coffin, J. P.; Frick, G.; Jundt, F. (Institut de Recherches Nucleaires, Strasbourg). Nucl. Phys., 73: 74-80(1965). (In French).

A Siegbahn-Slätis intermediate-image magnetic pair spectrometer was modified to determine the multipolarity of electromagnetic transitions. The modification consists of placing in the spectrometer a specially designed spiral baffle system. In this way the monopole character of the transition between the 3.63 Mev excited level and the ground state of ^{18}O is confirmed. (auth)

43312 COUPLED-CHANNEL CALCULATION OF THE PHASE VARIATION IN THE SCATTERING OF α-PARTICLES BY Ni ISOTOPES. Tamura, Taro (Oak Ridge National Lab., Tenn.). Nucl. Phys., 73: 81-90(1965).

It is shown that coupled-channel calculations can fit very well the recent data by Meriwether et al., of the scattering of α particles of 25 to 100 Mev by Ni isotopes. It is shown in particular that the energy variation of the phase of the inelastic scattering cross section relative to that of the elastic cross section is reasonably explained in this way. (auth)

43313 THE M/L CAPTURE RATIO OF ^{127}Xe. Winter, G.; Hohmuth, K.; Schintlmeister, J. (Zentralinstitut fuer Kernforschung Rossendorf, Ger.). Nucl. Phys., 73: 91-6 (1965). (In German).

The M/L electron capture ratio of ^{127}Xe was measured by means of a multiwire proportional counter. The result $P_M/P_L = 0.183 \pm 0.025$ is compared with the calculations of Bahcall and of Robinson. The decay energy of ^{127}Xe was determined to be $Q_{EC\oplus} = 438 \pm \frac{1}{2}$ kev. A redetermination of the half life yields the value $T_{\frac{1}{2}} = 36.5 \pm 0.1$ days. The cross section for the reaction ^{126}Xe(n,γ)^{127}Xe for pile neutrons was obtained as $\sigma = 0.7 \pm 0.4$ b. (auth)

43314 ON ISOBARIC ANALOGUE STATES. Jaenecke, Joachim (Technische Hochschule, Karlsruhe, Ger.). Nucl. Phys., 73: 97-112(1965).

The excitation energies of isobaric analog states, i.e., the energetically lowest states with a given isobaric spin T, are related to the symmetry and pairing energies of the respective nuclei. Symmetry parameters α(A) and pairing energies δ(A) were extracted from the experimental data. The parameter α(A) exhibits shell structure. An expression for the energetic difference between isobaric analog states was established which reproduces the over 200 known values (known experimentally or calculated from the known masses neighboring isobars) up to A = 80 with a standard deviation of about 0.5 Mev. The same formula can be used to predict excitation energies of unknown isobaric analog states and the masses of unknown neutron-rich and proton-rich nuclei. The expression is in accordance with a theoretical expression based on an effective two-nucleon interaction. There exist small but systematic deviations from the supermultiplet model. (auth)

43315 THE REACTION ^{30}Si(α,γ)^{34}S. McMurray, W. R. (Southern Universities Nuclear Inst., Faure, S. Africa); Van Heerden, I. J.; Wiechers, G. Nucl. Phys., 73: 113-21 (1965).

The radiative-capture alpha-particle reaction in ^{30}Si was studied in the energy range from 3.25 to 4.25 Mev. Thirty-six resonances corresponding to excited states in ^{34}S were observed, and, for sixteen of these which decay appreciably by ground state transitions, the spins and parities were uniquely determined by angular distribution measurements. The main modes of decay were obtained from gamma spectra and the partial resonance strengths of these levels evaluated. The average values of the deduced radiative widths in Weisskopf units agree with measurements of E1 and E2 transitions in other nuclei. (auth)

43316 ABSOLUTE CROSS-SECTIONS AND EXCITATION FUNCTIONS FOR α-PARTICLE INDUCED REACTIONS ON Zn BETWEEN 11 AND 24 Mev. Cogneau, M.; Gilly, L. J. (Universite, Louvain, Belg.). Nucl. Phys., 73: 122-30(1965).

Absolute cross sections and excitation functions between 11 and 24 Mev were measured for the following reactions: ^{64}Zn(α,n)^{67}Ge, ^{64}Zn(α,pn)^{66}Ga, ^{66}Zn(α,n)^{69}Ge 40, ^{66}Zn(α,3p)^{67}Cu, ^{66}Zn(α,pn)^{68}Ga, ^{67}Zn(α,2n)^{69}Ge 40, ^{67}Zn(α,p2n)^{68}Ga, and ^{68}Zn(α,αp)^{67}Cu. This was done by activation and stacked foil techniques. The experimental results were compared with theoretical predictions based on optical model and statistical analyses. The magnitude of the total cross section is closer to the optical model one, but the excitation function seems to be shifted in energy. For the ^{64}Zn + α compound nucleus the order of occurrence of the various reactions with increasing energy is (α,n) and (α,pn), whereas for the ^{66}Zn + α compound nucleus the order is (α,n), (α,3p), and (α,pn). The excitation functions for both (α,pn) reactions are very similar. (auth)

43317 LOW-LYING ENERGY LEVELS IN ODD-MASS Sc ISOTOPES. Plendl, H. S.; Defelice, L. J.; Sheline, R. K. (Florida State Univ., Tallahassee). Nucl. Phys., 73: 131-44(1965).

The reactions ^{46}Ti(p,α)^{43}Sc, ^{48}Ti(p,α)^{45}Sc, and ^{50}Ti(p,α)^{47}Sc were initiated in isotopically enriched and natural targets with protons of 9, 9.5, and 10 Mev from a tandem accelerator. The reaction products were analyzed and detected at 45, 60, and 125° with a magnetic spectrograph. The Q values, excitation energies, and absolute cross sections were determined. The energy level spectra of ^{43}Sc, ^{45}Sc, and ^{47}Sc emerging from this and other recent work are used to determine the applicability of several nuclear models to these nuclei. (auth)

43318 THE ^{39}K(p,p′) REACTION AT 140 Mev. Newton, D.; Clegg, A. B.; Salmon, G. L. (Oxford Univ.). Nucl. Phys., 73: 145-54(1965).

Measurements are presented of the states excited in the ^{39}K(p,p′) reaction. The states most strongly excited are at 2.82, 3.60, and 4.1 Mev, and it is shown that they are most probably components of the octupole vibration. Evidence is presented for important quadrupole excitation of the $2s_{\frac{1}{2}}$ and $1d_{\frac{3}{2}}$ hole states, corresponding to similar rapid electric quadrupole radiative decays of such states in other nuclei formed by adding a single nucleon or a single hole to a closed shell nucleus. (auth)

43319 INVESTIGATIONS OF THE MECHANISM OF THE ^{40}Ca(d,p)^{41}Ca REACTION AT THE BOMBARDING ENERGIES E_d = 1.9-2.0 Mev. Fodor, Ilona; Szentpetery, I.; Zimanyi, J. (Central Research Inst. for Physics, Budapest). Nucl. Phys., 73: 155-60(1965).

The absolute differential cross sections for the ^{40}Ca (d,p)^{41}Ca reaction leading to the ground and first excited states were measured at bombarding deuteron energies E_d = 1.9 and 2.0 Mev. The results are discussed in terms of the DWBA model of stripping reactions. (auth)

43320 THE ^{13}C(^{3}He,n$_0$)^{15}O REACTION AT 1.4 TO 5.8 Mev. Din, G. U.; Weil, J. L. (Rice Univ., Houston, Tex.). Nucl. Phys., 73: 161-73(1965). (TID-12810).

Excitation functions at 0, 90, and 150° for the ground state neutron group from ^{13}C(^{3}He,n)^{15}O were measured for ^{3}He bombarding energies from 1.40 to 5.80 Mev. The 0° yield curve shows a prominent peak of 300-kev width at $E_{^3He} = 2.0$ Mev and more complex structure at higher energies with several maxima. The 90 and 150° excitation functions show three and two broad peaks respectively superimposed on slowly rising cross sections. Twelve angular distributions were measured at 1.70, 1.96, 2.27, 2.66, 2.96, 3.27, 3.44, 3.83, 4.40, 4.67, 5.00, and 5.35 Mev bombarding energy. Below 2.3 Mev bombarding energy, the shape of the angular distribution changes radically with increasing energy. Above 2.7 Mev, the angular distribu-

tions all show a strong 0° peak and a second smaller maximum at about 100°. Analysis of the angular distributions into sums of Legendre polynomials indicates resonances in the reaction at about 2.0 and 3.25 Mev bombarding energy. Above 3 Mev, the forward peak of the angular distributions can be well fitted by Newns' double stripping theory. (auth)

43321 CIRCULAR POLARIZATION MEASUREMENTS AND FIRST-FORBIDDEN MATRIX ELEMENTS IN ^{72}Ga AND ^{124}Sb. Camp, D. C.; Mann, L. G.; Bloom, S. D. (Univ. of California, Livermore). Nucl. Phys., 73: 174-92(1965). (UCRL-12437).

Circular polarization measurements are reported for the γ rays following the outer beta transitions in the decay of ^{72}Ga and ^{124}Sb. For ^{72}Ga the degrees of polarization $P_c = 0.69 \pm 0.13$ at $\theta_{\beta\gamma} = 146°$ and $P_c = 0.74 \pm 0.08$ at $\theta_{\beta\gamma} = 157°$ were found, and for ^{124}Sb, $P_c = 0.51 \pm 0.05$ at $\theta_{\beta\gamma} = 146°$. These results were combined with published data on the β spectrum shape and the $\beta-\gamma$ directional correlation by using a computer program based on the equations of Newsome and Fischbeck which calculated nuclear matrix elements for these two cases. In both cases results indicate that the $\langle B_{11}\rangle$ matrix element makes the dominant contribution while the three rank-1 matrix elements are suppressed by a factor of about 100 compared with single-particle predictions. The conserved vector current ratio ($\Lambda = \langle\alpha\rangle/\langle\gamma\rangle$) of Fujita was also used in both cases to determine a set of nuclear matrix elements. It appears, however, that the uncertainties in predicting this ratio are so large that Λ is essentially without significance in the determination of nuclear matrix elements. (auth)

43322 MATRIX ELEMENTS FOR A THREE-NUCLEON SYSTEM. [PART] I. Davies, B. (Univ. of New South Wales, Kensington, Australia). Nucl. Phys., 73: 193-205 (1965).

Matrix elements of the kinetic energy and some common potential energy operators are given for the three-nucleon system, using a classification of the wave function recently given by Kalotas and Delves. The matrix elements, which are functions of the interparticle distances only, are given for arbitrary states of the system. (auth)

43323 TOTAL PROTON AND DEUTERON REACTION CROSS-SECTIONS IN THE ENERGY RANGE 8.5 TO 11.5 Mev. Bearpark, K.; Graham, W. R.; Jones, G. (Oxford Univ.). Nucl. Phys., 73: 206-16(1965).

Results of total proton reaction cross sections are presented for Al, Fe, Co, Ni, ^{58}Ni, ^{60}Ni, Cu, ^{63}Cu, ^{65}Cu, Zn, Ag, Cd, In, and Au in the energy range 8.5 to 11.5 Mev, and for the total deuteron reaction cross section for Ni, ^{58}Ni, ^{60}Ni, Cu, ^{63}Cu, and ^{65}Cu at 11 Mev. The method used is an attenuation technique in which the number of particles removed from the incident beam, during passage through a thin target, is determined by measuring the electric charge transferred to the target system as a result of absorption processes. (auth)

43324 THE GYROMAGNETIC RATIO OF THE FIRST EXCITED 2^+ STATE OF ^{182}W AND ^{184}W. Ebert, W.; Klepper, O.; Spehl, H. (Universitaet, Freiburg i. B.). Nucl. Phys., 73: 217-24(1965).

The gyromagnetic ratios of the 100-kev 2^+ state of ^{182}W and the 111-kev 2^+ state of ^{184}W were measured by observing the time integrated precession of the gamma angular distribution following Coulomb excitation with a neutral hydrogen beam. Thick metallic targets of separated isotopes were used. Particular attention is given to the effects of internal perturbations by a randomly oriented static quadrupole interaction. The values of the g factors are $g = 0.249 \pm 0.024$ for ^{182}W and $g = 0.282 \pm 0.018$ for ^{184}W. (auth)

43325 EMPIRICAL DATA CONCERNING THE ELECTRIC QUADRUPOLE MOMENTS. Hamamoto, Ikuko (Tokyo Univ.). Nucl. Phys., 73: 225-33(1965).

Experimental data on the electric quadrupole transition probability of even nuclei and the electric quadrupole moment of odd-mass nuclei are collected and discussed. From the empirical magnitude of the moments it is suggested that the neutron-proton interaction plays an important role both in the spherical region and in the deformed one. (auth)

43326 MASS-FISSION-YIELD CURVE FOR ^{241}Am. Rickard, R. R.; Goeking, C. F.; Wyatt, E. I. Nucl. Sci. Eng., 23: 115-18(Oct, 1965).

Mass-yield measurements were made for the fission of ^{241}Am induced by graphite-moderated reactor neutrons. In most cases gamma-ray spectrometry was used to measure the radioactivity of the isolated fission products. The relative abundance of each nuclide representing a particular fission chain was determined radiochemically with respect to ^{139}Ba, whose fission yield was assumed to be 6.22%. The composite results of the three separate experiments are presented. (auth)

43327 SOME REMARKS ON THE REDUCTION OF THERMAL-NEUTRON ACTIVATION RATES TO A DIFFERENTIAL SPECTRUM. Ibarra, H.; Sher, R. (Stanford Univ., Calif.). Nucl. Sci. Eng., 23: 197-9(Oct, 1965).

In examining the limitations of the orthonormalization expansion of neutron spectra with activation measurements, Gold (Nucl. Sci, Eng., 20: 493-512 (1964)) points out that the absolute value of the determinant of B, does not always afford a criterion sensitive enough to uncover a source of ill-conditioning of B. Regarding this, it is remarked that it is perhaps possible that with the normalization of the row vectors of B, the resulting determinant will then be sensitive enough to uncover the source of ill-conditioning. Also in the development of techniques for the reduction of thermal-neutron activation rates to a differential spectrum, the orthonormalization of a linearly independent set of expansion functions using different weighting functions in the orthonormalization process were proposed. Regarding this, it is shown that once a linearly independent set of expansion functions is chosen, any linearly independent set derived from these by linear combinations results mathematically in the same expanded neutron spectrum. (J.F.P.)

43328 MAGNETIC ELASTIC ELECTRON SCATTERING FROM ^{9}Be, ^{10}B AND ^{11}B. Vanpraet, G. J.; Kossanyi-Demay, P. (Stanford Univ., Calif.). Nuovo Cimento (10), 39: 388-90(Sept. 1, 1965).

The magnetic dipole form factors of the p-shell nuclei ^{9}Be, ^{10}Be, and ^{11}B were measured for values of $q^2 < 0.5$ Fermi^{-2}, by elastic electron scattering at 180°. Results for cross sections and magnetic form factors are given; the form factors were obtained by fitting the data to an expression calculated using the single-particle, harmonic-well, shell model. (M.J.T.)

43329 COLLECTIVE RETARDATION IN MASS 15 NUCLEI. Rose, H. J.; Lopes, J. S. (Nuclear Physics Lab., Oxford). Phys. Letters, 18: 130-1(Aug. 15, 1965).

Evidence is presented that suggests that the 6.15- and 6.33-Mev, $J^\pi = 3/2^-$ mirror states in ^{15}O and ^{15}N are more accurately described as a $P_{\frac{1}{2}}$ hole in the 2^+, 6.92-Mev state of ^{16}O than as a $P_{\frac{1}{2}}$ hole in the ^{16}O ground state. (L.B.S.)

43330 INTERNAL PAIR FORMATION IN ^{60}Ni AND ^{24}Mg MEASURED BY THE DETECTION OF ANNIHILATION RADIATION. Spring, E. (Univ. of Helsinki). Phys. Letters, 18: 132-4(Aug. 15, 1965).

Internal pair formation in ^{60}Ni and ^{24}Mg was studied using a conventional γ-γ coincidence apparatus and 9.7 ± 0.1 μc ^{60}Co source. Triple coincidence techniques were used to determine the ratio of pairs originating from different transitions. The experimental and theoretical internal pair formation coefficients for E2-transitions are tabulated. (L.B.S.)

43331 LEVELS OF ^{20}Ne FROM RADIATIVE ALPHA-CAPTURE IN ^{16}O. Van der Leun, C.; Sheppard, D. M.; Smulders, P. J. M. (Fysisch Laboratorium R.U., Utrecht). Phys. Letters, 18: 134-5(Aug. 15, 1965).

An investigation was made of the $^{16}O(\alpha,\gamma)^{20}Ne$ reaction, which is considered to be the principal process in the stellar production of ^{20}Ne. Yield curves were measured

using natural SiO_2 and CaO_2 targets at alpha energies of 1.1 to 2.55 Mev. The resonance strengths and partial widths were determined for the ^{20}Ne 5.62- and 5.79-Mev levels with $J^\pi = 3^-$ and 1^-, respectively, and also for the 6.72-Mev level with $J^\pi = 0^+$. The results are tabulated and discussed. (L.B.S.)

43332 SCATTERING OF PHOTONS BY DEFORMED EVEN-EVEN NUCLEI IN THE DYNAMIC COLLECTIVE THEORY. Arenhoevel, H.; Greiner, W. (Universitaet, Frankfurt am Main). Phys. Letters, 18: 136-8(Aug. 15, 1965).

The differential cross sections were calculated for photon scattering into the ground-state band $(0^+,2^+)$, the γ-band (2^+), the β-band $(0^+,2^+)$, and the $(K = 0, N_2 = 1)$-band $(0^+,2^+)$ for the case of ^{166}Er, using the dynamic collective theory for computing the nuclear matrix elements. The energies, widths of the various nuclear states, and the reduced matrix elements are tabulated. The cross section curves are shown for incident photons of 8 to 22 Mev at 135°. The total cross sections are compared with experimental data for ^{165}Ho. (L.B.S.)

43333 FINITE RANGE OF DATA EFFECTS ON CROSS-SECTION FLUCTUATION ANALYSIS. Dallimore, P. J.; Hall, I. (Nuclear Physics Lab., Oxford). Phys. Letters, 18: 138-9(Aug. 15, 1965).

The Breit-Wigner resonance denominator is used in estimating the finite range of data errors in the statistical analysis of cross section data. Comparison is made of auto-correlation values for $\Gamma/D = \frac{1}{2}$ and 2, where Γ is the mean level width and D is the level spacing, which suggests that $\Gamma/D = 2$ is sufficient for carrying out a fluctuation analysis. No significant difference was found between random, Wigner, and equal spacing distribution of the energy levels. (L.B.S.)

43334 MODULATED FLUCTUATIONS IN THE REACTION $^{26}Mg(p,\alpha)^{23}Na$. Allardyce, B. W. (Nuclear Physics Lab., Oxford); Dallimore, P. J.; Hall, I.; Tanner, N. W.; Richter, A.; Von Brentano, P.; Mayer-Kuckuk, T. Phys. Letters, 18: 140-1(Aug. 15, 1965).

Excitation functions for the $^{26}Mg(p,\alpha)^{23}Na$ reaction were measured at various angles for proton energies of 9 to 13 Mev in 20-kev steps. The data were analyzed by conventional correlation functions and were compared with statistical predictions, in order to test quantitatively the fluctuation theory. It is concluded that the statistical theory is inadequate, even when errors and corrections due to the finite range of data are considered; and that consistency could be attained by a modification of the theory to take into account non-statistical variations in cross section which are manifested as energy variations of the local mean. (L.B.S.)

43335 A COMPARISON OF THE MIRROR REACTIONS $^{10}B(d,^3He)^9Be$ AND $^{10}B(d,t)^9B$. Symons, G. D. (California Inst. of Tech., Pasadena). Phys. Letters, 18: 142-3 (Aug. 15, 1965).

A search was made for a state in ^9B analogous to the 1.70-Mev state in ^9Be in a comparative study of the $^{10}B(d,^3He)^9Be$ and $^{10}Be(d,t)^9B$ reactions at 10 Mev. The non-observance of triton groups predicted at ~1.5 and 2.8 Mev corresponding to the 1.70 and 3.04 Mev states in ^9Be is explained as being obscured by the continuous contribution from alternative modes of decay. The spectrum from the $^{10}Be(^3He,\alpha)^9B$ reaction was also studied, which substantiated previous evidence of a 2.8 Mev state in ^9B. (L.B.S.)

43336 ON A POSSIBLE METHOD FOR STUDY OF HIGHLY EXCITED LEVELS WITH THE HELP OF CAPTURE GAMMA RAYS. Breunlich, W.; Hille, P.; Tagesen, S. (Institut fuer Radiumforschung und Kernphysik, Vienna). Phys. Letters, 18: 144(Aug. 15, 1965). (In German).

A method is proposed in which the angular-dependent Doppler shift occurring in the resonant scattering of gamma radiation on heavy nuclei is used for investigating highly excited levels in nuclei. (L.B.S.)

43337 MEASUREMENT OF α_K, α_{TOTAL} AND K/(L + M) FOR ELECTRON CAPTURE TRANSITIONS IN ^{113m}In AND ^{109m}Ag WITH A SOLID STATE DETECTOR. Sen, S. K.; Durosinmi-Etti, I. O. (Univ. of Manitoba, Winnipeg). Phys. Letters, 18: 144-6(Aug. 15, 1965).

The conversion electron spectra of the 393-kev transition in ^{113m}In and the 88-kev transition in ^{109m}Ag were obtained with a Au-Si surface barrier diode, operated at room temperature, and a NaI(Tl) crystal. The conversion coefficients α_K, α_{total}, and K/(L + M) were determined and the results are tabulated. (L.B.S.)

43338 ENERGY LEVEL STRUCTURE OF ^{231}Th, ^{235}U, ^{237}U, ^{241}Pu AND ^{243}Pu AS OBSERVED AT HIGH RESOLUTION WITH (d,p) REACTIONS. Braid, T. H.; Chasman, R. R.; Erskine, J. R.; Friedman, A. M. (Argonne National Lab., Ill.). Phys. Letters, 18: 149-54(Aug. 15, 1965).

The proton spectra were measured for the (d,p) reactions with ^{230}Th, ^{234}U, ^{236}U, ^{240}Pu, and ^{242}Pu at 11.96 Mev and analyzed with an automatic fitting program on a digital computer. The excitation energies, Q values, and relative differential cross sections at 140° are tabulated for all levels observed. The total angular momentum of some levels are also given along with the Nilsson level assignment. In addition, a single-particle neutron spectrum is constructed from the Pu data; and the observed levels in ^{241}Pu and ^{243}Pu are compared with states calculated with the pairing-force model. (L.B.S.)

43339 THE SCATTERING OF 33 Mev ^3He ON THE EVEN-A NICKEL ISOTOPES. Siemssen, R. H.; Braid, T. H.; Dehnhard, D.; Zeidman, B. (Argonne National Lab., Ill.). Phys. Letters, 18: 155-7(Aug. 15, 1965).

Differential cross sections for the elastic scattering of 33 Mev ^3He particles on enriched targets of ^{58}Ni, ^{60}Ni, ^{62}Ni, and ^{64}Ni were measured from 25° to 90° in 2.5° steps at forward angles and 3° steps at larger angles. Optical model calculations were performed, with all parameters varying except the radius of the real potential well and the Coulomb radius parameter, in search for the best fit to the data for each isotope, and also using a common potential for the four isotopes. It was found that the common set of parameters reproduces the general shape of the experimental angular distributions and the major differences between the isotopes remarkably well, which demonstrates the success of the optical model for ^3He scattering. (L.B.S.)

43340 NUCLEAR HARTREE-FOCK CALCULATIONS. Muthukrishnan, R.; Baranger, M. (Carnegie Inst. of Tech., Pittsburgh). Phys. Letters, 18: 160-3(Aug. 15, 1965).

The results of a Hartree-Fock calculation of the single particle levels and binding energies of ^{12}C, ^{16}O, ^{28}Si, ^{40}Ca, and ^{90}Zr are presented. The equations were solved by the matrix method on the basis of harmonic oscillator wave functions. (L.B.S.)

43341 CALCULATIONS OF INTERNAL CONVERSION COEFFICIENTS. Seltzer, E.; Hager, R. (California Inst. of Tech., Pasadena). Phys. Letters, 18: 163-5(Aug. 15, 1965).

Calculations are made of conversion coefficients in the L-shell for M1 and E2 multiple radiation as a function of atomic number and gamma energies. The results are compared with those of Sliv and Rose. (L.B.S.)

43342 THE (t,p) REACTION AS A MEANS OF DISTINGUISHING AMONG OPTICAL MODEL POTENTIALS SATISFYING TRITON ELASTIC SCATTERING. Glover, R. N. (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.); Jones, A. D. W. Phys. Letters, 18: 165-6 (Aug. 15, 1965).

Four sets of parameters previously given for describing triton elastic scattering are used for DWBA analysis of the $^{12}C(t,p)^{14}C$ and $^{16}O(t,p)^{18}O$ reactions. The theoretical angular distributions are compared with experimental data, and the results show significant dependence of the DWBA calculations on the optical potential used. (L.B.S.)

43343 NUCLEAR MAGNETIC SUSCEPTIBILITY OF ^{3}He VAPOR. Opfer, J. E.; Luszczynski, K.; Norberg, R. E. (Washington Univ., St. Louis). Phys. Rev., 140: A100-6(Oct. 4, 1965).

Measurements of relative values of the nuclear magnetic susceptibility of ^{3}He vapor were made by a pulsed resonance technique for several values of vapor density at 2 and 3.1°K. The results of these measurements show that deviations from Curie's law are considerably smaller than those expected for a perfect Fermi gas. A theoretical expression is derived for the susceptibility at vapor densities sufficiently low that only binary collisions are important; a modification of the calculation of the second virial coefficient is used to evaluate the effect of direct interactions. The susceptibility is related to the difference between two virial coefficients, that of ^{3}He and that calculated for a hypothetical ^{3}He with zero spin. The theoretical results are in good quantitative agreement with the experimental data. They indicate that the perfect-Fermi-gas theory is not applicable to the calculation of the susceptibility of ^{3}He vapor at low density except at temperatures lower than 0.002°K. Moreover, from the theoretical results it is concluded that deviations from Curie's law in the vapor are expected to be less than about 1% whenever higher order collisions do not contribute significantly to the interaction between ^{3}He atoms. (auth)

43344 NUCLEAR SPIN RELAXATION AND DOUBLE RESONANCE IN HD GAS. Nageswara Rao, B. D.; Anders, L. R. (Harvard Univ., Cambridge, Mass.). Phys. Rev., 140: A112-17(Oct. 4, 1965).

Nuclear magnetic double-resonance experiments were performed on a gaseous sample containing a mixture of HD and CO_2 at high pressure by observing the spin-spin multiplet in the proton-resonance spectrum and irradiating either the deuteron transitions or some of the proton transitions. The spectra show features arising from spin relaxation in HD. These features are analyzed by using the density-matrix theory of double resonance, assuming "strong"- and "weak"-collision models for the system. The equation of motion of the spin density matrix is exactly of the same form for both collision models, the only distinction coming from the dependence of the correlation times on the transformation properties of the lattice operators and on the quantum numbers characterizing the lattice states. The results of the analysis of HD double-resonance spectra indicate that the collisions in this case are "strong." The cross products between lattice terms which transform identically but belong to two different relaxation mechanisms make significant contributions to some of the correlation functions involved and thereby affect the final results. (auth)

43345 RANGES OF ^{11}C IN ALUMINUM. Panontin, J. A.; Schwartz, L. L.; Stehney, A. F.; Steinberg, E. P.; Winsberg, L. (Argonne National Lab., Ill.). Phys. Rev., 140: A151-5(Oct. 4, 1965).

The ranges of 0.66- to 1.64-Mev ^{11}C atoms in aluminum were determined by the stacked-foil catcher technique. Monoenergetic ^{11}C recoils were produced from the interaction of 3.94- to 6.96-Mev protons with thin ^{11}B targets in the reaction ^{11}B(p,n)^{11}C. The results are compared with previous data and theoretical calculations, and are in agreement with the semiempirical calculations of Northcliffe. (auth)

43346 NUCLEAR-MAGNETIC-RESONANCE STUDY OF HYDROGEN ALLOYING IN THE EARLY TRANSITION METALS (GROUP VB). Zamir, D. (Israel Atomic Energy Commission, Yavne). Phys. Rev., 140: A271-4 (Oct. 4, 1965).

The Knight shifts and spin-lattice relaxation times of vanadium and niobium in the VH_x and NbH_x systems, respectively, were measured. From the observed relaxation-time temperature dependence, the contribution of the conduction electrons to the nuclear relaxation was found. A comparison of the Knight shifts and the relaxation times of V and Nb in the hydrides with those in the corresponding alloys, VCr_x and $NbMo_x$, shows great similarity. Some conclusions are drawn about this similarity. Using a Korringa-type relation for Nb in the NbH_x system, information about the type of conduction electrons giving rise to the Knight shift and relaxation rate is obtained. (auth)

43347 NUCLEAR MAGNETIC RESONANCE OF SOLIDIFIED H_2–D_2 MIXTURES. I. STEADY-STATE EXPERIMENTS. Gaines, J. R.; de Castro, E. M.; Daunt, J. G. (Ohio State Univ., Columbus). Phys. Rev., 140: A319-29(Oct. 4, 1965).

Steady-state NMR measurements using a marginal oscillator technique at 10 Mc/sec were made on solid mixtures of n-H_2–n-D_2 of n-H_2 concentration from 100% to 1% in the temperature range 1.1°K to about 12°K. Striking differences in the line shape were observed, particularly in the n-D_2-rich sample, with change in temperature, the line shape at the lowest temperatures revealing a composite structure. The question whether this line shape transition is due to isotopic phase separation is discussed, and this interpretation is considered unlikely. It is concluded that the transition is probably associated with a hindering of the rotation of the ortho-H_2 molecule. Narrowing of the resonance lines with increasing rf power was observed. It is shown that no satisfactory explanation of this effect is possible using the Bloch equations. This narrowing is in excellent agreement with a recent calculation by Provotorov, however, and his theory is used to obtain a value of the exchange interaction in solid H_2 of approximately 10^{-7} °K. The progressive-saturation technique is used to obtain values of the product T_1T_2 for several of the mixtures. The data showed that T_1T_2 has a value at 4.2°K of about 2×10^{-8} sec^2 for concentrations of n-H_2 from 10% to 100%. (auth)

43348 BINDING ENERGY OF THE FOUR-NUCLEON SYSTEM WITH SEPARABLE POTENTIAL. Panchapakesan, Nargis (Univ. of Delhi). Phys. Rev., 140: B20-5 (Oct. 11, 1965).

Following the approach of Mitra a four-body formalism is set up for the α-particle system under the condition of full antisymmetrization of the four nucleon wave function. The N-N s state interaction considered is of the separable type and the shape is assumed to be Gaussian. The resulting equations are solved (under certain approximations) for the α-particle ground-state energy. Using the above simplified interaction it is found that this approach leads to overbinding in the four-nucleon system. (auth)

43349 PARTICLE CORRELATION ARISING FROM ISOSPIN PAIRING IN LIGHT NUCLEI. Goswami, A.; Kisslinger, L. S. (Western Reserve Univ., Cleveland; Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 140: B26-31(Oct. 11, 1965).

A new kind of particle correlation in light nuclei consisting of neutron-proton pairs in T = 0 states is considered which is called isospin pairing. The importance of such a correlation stems from the fact that the n-p T = 0 force is dominant for A ≤ 30, especially for N = Z nuclei. It is shown that such an isospin correlation is coherent and, among other things, can provide the necessary decrease in the ground-state band moment of inertia of N = Z even-even nuclei. Detailed properties of the variational wave function are discussed. The possibility of understanding the deformation of light nuclei as a result of competition between T = 0 and T = 1 forces is pointed out. (auth)

43350 MUON CAPTURE IN ^{16}O. Gillet, Vincent; Jenkins, David A. (Univ. of California, Berkeley). Phys. Rev., 140: B32-41(Oct. 11, 1965). (UCRL-16029).

The muon capture rate in oxygen is used as a means for measuring the induced pseudoscalar coupling constant (C_P) of weak interactions. The capture rate between the $J^P = 0^+$ ground state of ^{16}O and the 0^-, 1^-, 2^-, and 3^- states of ^{16}N are calculated as a function of C_P with different nuclear models. C_P is then determined using the experimental values of the transition rates. It is found that the transition rate, and therefore C_P, depends strongly on the nuclear model. It is concluded that $5 < C_P/C_A < 20$. (auth)

43351 INELASTIC DEUTERON SCATTERING AND (d,p) REACTIONS FROM ISOTOPES OF TITANIUM. III. ^{49}Ti(d,p)^{50}Ti. Barnes, P. D. (Yale Univ., New Haven); Bockelman, C. K.; Hansen, Ole; Sperduto, A. Phys. Rev., 140: B42-7(Oct. 11, 1965).

Fifty-six levels in ^{50}Ti were excited by the (d,p) reaction on ^{49}Ti at 6-Mev bombarding energy. The differential cross sections for the proton groups were measured at 23 scattering angles. A distorted-wave analysis of the experimental results yielded values of the orbital angular momenta of the transferred neutron and transition strengths for 44 of the observed transitions. A sum-rule analysis indicates that all of the $1f_{\frac{1}{2}}$, $2p_{\frac{1}{2}}$, and $2p_{\frac{3}{2}}$ single-particle strengths and 60% of the $1f_{\frac{3}{2}}$ strength were observed. The present data are compared to other experimental evidence on ^{50}Ti, and a level scheme for ^{50}Ti is proposed. The spectroscopic data are discussed in terms of the shell model with residual interactions. The results for the transitions to the ground state and three lowest excited states of ^{50}Ti are shown to be in disagreement with seniority conservation. (auth)

43352 CROSS SECTIONS FOR THE ^{51}V(γ,π^-2n)^{49}Cr REACTION. Meyer, Richard A.; Hummel, John P. (Univ. of Illinois, Urbana). Phys. Rev., 140: B48-9(Oct. 11, 1965).

Cross sections from threshold to 300 Mev were determined for the ^{51}V(γ,π^-2n)^{49}Cr reaction from measurements of the ^{49}Cr radioactivity produced in high-energy bremsstrahlung irradiations of natural vanadium metal targets. The observed cross sections rise to 100 μb at 210 Mev and then decrease to 40 μb at 300 Mev. The cross sections are interpreted in terms of a mechanism in which the pion-production process is considered to be a single-nucleon process and the recoiling proton interacts with the nucleus to cause the emission of two neutrons. In the calculations the pion-production cross sections in ^{51}V are obtained by using the free-nucleon cross sections and assuming the $A^{\frac{2}{3}}$ dependence that is indicated by previous pion yield measurements. The gross features of the observed cross sections for the ^{51}V(γ,π^-2n)^{49}Cr reaction can then be reproduced by using reasonable values for the branching ratios for the emission of two neutrons. (auth)

43353 THORIUM RESONANCE PARAMETERS FOR NEUTRON ENERGIES FROM 20 TO 222 ev. Haddad, E.; Freisenhahn, S. J.; Froehner, F. H.; Lopez, W. M. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Phys. Rev., 140: B50-62(Oct. 11, 1965). (GA-6272).

The neutron capture cross section for thorium was measured over the neutron energy region from 20 to 222 ev. The pulsed neutron source for this investigation was obtained by stopping 30-Mev electrons in a water-moderated Fansteel target. The gamma rays resulting from neutron capture were detected by a 4000-liter liquid scintillator. Resonance parameters for the predominant s-wave levels were determined from the cross-section data. The resonance parameters were obtained by means of the multisample area-analysis technique. This analysis included multiple-scattering corrections. Of the 11 resonances studied the data indicate that, within the quoted experimental errors, the radiation width remained constant from level to level. The average value obtained for the radiation width was 24.5 ± 1.5 Mev. (auth)

43354 TEST OF THE BOUNDARY-CONDITION CONSTRAINT METHOD FOR NUCLEAR REACTIONS. Nagarajan, M. A.; Shah, S. K.; Tobocman, W. (Case Inst. of Tech., Cleveland). Phys. Rev., 140: B63-8(Oct. 11, 1965).

The boundary-condition constraint method (BCCM) is a generalization of R-matrix theory that permits the shell model to be used as a basis for nuclear-reaction calculations and which permits the correct far-asymptotic behavior of the wave function to be imposed as a constraint on shell-model bound-state calculations. For practical application it is necessary to truncate sums over an infinite number of levels. The effectiveness of the few-level approximation is investigated. The BCCM is used to calculate an s-wave bound state for a square well in the two- and three-level approximations. The BCCM results are found to compare favorably with the exact and shell-model results. The BCCM is used to calculate the s- and p-wave scattering from a square well in the two- and three-level approximations. The results are found to compare favorably with the exact and Wigner R-matrix-theory results. It is noted that within the n-level approximation there is some ambiguity in the form of the Green's function to be used with the BCCM. (auth)

43355 TENSOR POLARIZATION OF DEUTERONS FROM THE ^{9}Be(p,d)^{8}Be REACTION. Darden, S. E.; Froelich, A. J. (Univ. of Notre Dame, Ind.). Phys. Rev., 140: B69-74(Oct. 11, 1965).

The second-rank tensor polarization parameters $\langle T_{2q}\rangle$ describing the deuterons produced in the ^{9}Be(p,d)^{8}Be reaction were measured for average proton bombarding energies of 2.5 and 3.7 Mev. Measurements were taken at ten-degree intervals for six emission angles between 0° and 50° in the laboratory system. The tensor moments were determined by observing the polar and azimuthal angular dependence of the intensity of the protons from the ^{3}He(d,p)^{4}He reaction when this reaction is initiated by deuterons from the ^{9}Be(p,d)^{8}Be reaction. Similar results were obtained at both of the bombarding energies investigated. The $\langle T_{2q}\rangle$ are generally negative, with absolute magnitudes of the order of 0.20 or less. Preliminary calculations of the $\langle T_{2q}\rangle$ using the distorted-wave Born approximation with spin-orbit terms in the distorting potentials agree generally in sign with the measured values, but are consistently smaller than these by at least an order of magnitude. (auth)

43356 MODERATION AND CASCADE TIMES OF NEGATIVE PIONS AND NEGATIVE KAONS IN LIQUID HELIUM. Block, M. M.; Kopelman, J. B.; Sun, C. R. (Northwestern Univ., Evanston, Ill.). Phys. Rev., 140: B143-52(Oct. 11, 1965).

Measurements were made of the mean moderation times $T_{\pi}^{He}(v_A)$ and $T_{K}^{He}(v_A)$, spent by π^- and K^-, respectively, in atomic orbits before nuclear capture in the Northwestern helium bubble chamber. It was necessary to resolve the velocities of π^- (or K^-) down to $v \approx 0.02c$. The resolution was obtained in the pion case by measuring the μ^- range from π^--μ^--e^- decays and in the kaon case by the kinematic analysis of the τ-decay mode. The following results are obtained: $T_{\pi}^{He}(0.02c) = (3.19 \pm 0.23) \times 10^{-10}$ sec, and $T_{K}^{He}(0.02c) = (2.4 \pm 0.4) \times 10^{-10}$ sec. These measured times are two orders of magnitude longer than that predicted by Day assuming dominant Stark effect and thus S-state capture. A recent calculation by Russell reduces the rate of Stark effect yet predicts cascade times still five times shorter than our experimental values. Thus the angular-momentum states of K^- capture in liquid helium, whose determination was the motivation for the present experiments, are still unknown without a detailed understanding of the de-excitation mechanism of the K-mesonic atom. (auth)

43357 ENERGY LEVELS OF ^{48}Sc FROM A STUDY OF NEUTRONS AND GAMMA RAYS EMITTED BY THE ^{48}Ca(p,nγ)^{48}Sc REACTION. Chasman, C.; Jones, K. W.; Ristinen, R. A. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 140: B212-16(Oct. 11, 1965). (BNL-9224).

Energy levels of ^{48}Sc up to 2.5 Mev excitation were studied by observation of neutrons and gamma rays produced in the ^{48}Ca(p,nγ)^{48}Sc reaction. Analysis of neutron spectra obtained at $E_p = 3.250$ Mev with a ^{3}He-filled proportional counter, and of gamma-ray spectra obtained at various proton bombarding energies with a lithium-drifted germanium gamma-ray detector, shows that the ^{48}Ca(p,n)^{48}Sc reaction does not populate the ^{48}Sc ground state directly. The ground-state-reaction Q value is found to be −529 ± 10 kev, which implies a mass excess of −44240 ± 14 kev for ^{48}Ca. Excited states of ^{48}Sc were established at 131 ± 2, 253 ± 2, 624 ± 3, 1144 ± 3, 1406 ± 3, 2192 ± 3, 2277 ± 3, and 2519 ± 5 kev. Possible spin assignments were deduced from the gamma-ray branching ratios. (auth)

43358 THE ^{20}Ne(α,γ)^{24}Mg REACTION. Smulders, P. J. M. (Rijksuniversiteit, Utrecht). Physica, 31: 973-81 (June 1965).

The reaction $^{20}Ne(\alpha,\gamma)^{24}Mg$ was investigated in the energy range E_α = 1.2 to 3.2 Mev. Twelve resonances were observed. Gamma-ray angular distribution and correlation measurements yield a unique spin and parity assignment for ten ^{24}Mg levels with excitation energies in the region E_x = 10.6-12.0 Mev. The resonance strengths and deduced radiative widths are reported. A strong preference is found for de-excitation through E2 radiation; E1 and M1 transitions are relatively weak, as expected from isospin selection rules. (auth)

43359 EFFECT OF GRAVITY ON NUCLEAR RESONANCE INTERACTION. Fokker, A. D. Physica, 31: 982-4(June 1965).

The Mössbauer effect is used to investigate the effect of gravity on nuclear resonance, since very sharp gamma rays are emitted in this effect. The effect in the laboratory is found to be vanishingly small. (J.F.P.)

43360 THE RANGE-ENERGY RATIO FOR Ag AND Br NUCLEI IN PHOTOEMULSION. Koz'min, V. A.; Ostroumov, V. I. (Leningrad Polytechnic Inst.). Pribory i Tekhn. Eksperim., No. 4, 49-51(July-Aug. 1965). (In Russian).

An analysis was made of the events of elastic scattering of fast ^{14}N ions on heavy emulsion nuclei, accompanied by the appearance of recoil particle tracks. On the basis of the results obtained curves were constructed on the dependence E(R) for Ag and Br nuclei in the energy range from 2 to 12 Mev. (tr-auth)

43361 SOME REMARKS ON THE E_2-M_1 MIXING RATIOS OF $2' \rightarrow 2$ TRANSITIONS IN EVEN-EVEN NUCLEI. Swarnagowri, S.; Ramaswamy, M. K. (Karnatak Univ., Dharwar, India). Proc. Indian Acad. Sci., Sect A, 61: 289-93(May 1965).

Experimental values of E_2-M_1 mixing ratios of $2'^+ \rightarrow 2^+$ transitions in even-even nuclei were found to decrease with increasing splitting of $2'^+$ and 4^+ levels. (auth)

43362 THE SPINS OF ODD-ODD NUCLEI. Nishibori, Yutaka (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 33: 1050-78(June 1965).

The spins of low-lying states of odd-odd nuclei are investigated in detail under the assumption of the j-j coupling odd-group model. For the sake of simplicity, only such nuclei are treated as have one proton (or hole) and one neutron (or hole) outside (inside) each core. The rule [R-3] for particle hole configurations reported by Brennan and Bernstein is derived from the rules [R-1] and [R-2] for particle-particle and hole-hole configurations. To investigated the rules [R-1] and [R-2], two-body matrix elements of the effective interaction are decomposed into the kinematical and dynamical factors using Talmi's method. The detailed analysis of the former factors imposes a few conditions on the latter factors to reproduce the rules, and it is found that Brueckner's K matrix satisfies these conditions reasonably, while usual phenomenologica residual forces do not satisfy some of these conditions. Finally the effects of noncentral forces are investigated. (auth)

43363 ON NUCLEAR BINDING ENERGY AND BETHE-WEIZSACKER RELATION. Dutta, A. K.; Pal, B.; Ganguly, P.; Banerjee, D. (University Coll. of Science, Calcutta). Progr. Theoret. Phys. (Kyoto), 33: 1129-31(June 1965).

It is shown that surface tension correction term in the Bethe-Weizacker relation for the nuclear binding energy may be eliminated. An expression is derived which consists of the three contributions: the energy proportional to the nucleon number, the Coulomb energy term, and the asymmetry term. (L.B.S.)

43364 NOTE ON THE VIBRATIONAL MOTION IN LIGHT NUCLEI. Nagata, Sinobu (Kyoto Univ.); Takada, Kenjiro; Takagi, Shuji. Progr. Theoret. Phys. (Kyoto), 33: 1135-7(June 1965).

Calculations were made of mass parameters B_β and B_γ and surface tension parameters C_β and C_γ in the collective model, using the Marumori formulation which connects the parameters in Bohr-Mottelson's model with the effective forces in nuclei. The results are compared with previous conclusions, and the validity of the approximation in Marumori formalism is discussed. (L.B.S.)

43365 FRAGMENT PRODUCTION MECHANISM INDUCED BY HIGH ENERGY PROTONS. Oishi, Kimiya; Hasegawa, Hiroichi (Gakushuin Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 33: 1137-9(June 1965).

The production of the neutron excess fragments, ^6He and ^8Li, and the neutron deficient fragments ^7Be, ^{13}N, and ^{18}F, is investigated. Calculations were carried out for ^{27}Al, ^{64}Cu, ^{107}Ag, and ^{197}Au targets bombarded by protons at 0.25 to 5 Bev. It is shown that the target mass dependence of $(E_B + E_C)$ is stronger for neutron deficient fragments than for the neutron rich ones (E_B and E_C are the fragment separation energy and the Coulomb energy between the fragment and the residual nucleus, respectively), which gives the basis of the target mass dependence of fragmentation cross section. It is concluded that most of the lighter fragments are emitted through the evaporation after the fast process. (L.B.S.)

43366 NEUTRINO PAIR EMISSION FROM EXCITED NUCLEI. [PART] II. Nishida, Minoru (Brandeis Univ., Waltham, Mass.); Sakashita, Shiro. Progr. Theoret. Phys. (Kyoto), 34: 188-9(July 1965).

Estimates were made of nuclear matrix elements, from which the neutrino emission rate from the 0.438 Mev level of ^{23}Na was found to be comparable with or greater than the sum of the rates of photoneutrinos, plasma neutrinos, and pair production neutrinos. (L.B.S.)

43367 RADIOCHEMICAL STUDIES OF $(p,p\pi^+)$ REACTION IN ^{115}In. Rybakov, V. N.; Mal'tseva, N. S. Radiokhimiya, 7: 90-5(1965). (In Russian).

Data on the excitation function of the $(p,p\pi^+)$ reaction with ^{115}In in the proton energy range from threshold up to 660 Mev are presented. Evaluation of the ratio $\sigma^{115m}Cd/\sigma^{115}Cd$ gave two reactions: (p,p^0) and $(p,p\pi^+)$. The experimental results led to satisfactory agreement with the theoretical calculations. (tr-auth)

43368 YIELDS OF ^{87}Br, ^{88}Br, ^{89}Br, ^{137}I AND ^{138}I ISOTOPES—PRECURSORS OF DELAYED NEUTRONS IN ^{238}U AND ^{232}Th FISSION BY 14.5 Mev NEUTRONS. Shpakov, V. I.; Kostochkin, O. I.; Petrzhak, K. A.; Aron, P. M. Radiokhimiya, 7: 96-103(1965). (In Russian).

The yields of the isotopes ^{86}Br, ^{87}Br, ^{88}Br, ^{89}Br, (^{90}Br), ^{136}I, ^{137}I, and ^{138}I, formed by the fission of ^{238}U and ^{232}Th by neutrons at 14.5 Mev, were investigated. It was established that the bromine activity with a half life of 1 minute separated from the fission products was represented by the sum of the activities of the ^{86}Br and ^{87}Br isotopes and not only ^{87}Br as assumed earlier. (tr-auth)

43369 NUCLEAR MODELS. Lueders, G. (Universitaet, Gottingen, Ger.). Studium Gen., 18: 193-8(1965). (In German).

A brief introduction to nuclear models is presented covering the basic atomic and nuclear physics as well as nuclear forces and structure. (D.C.W.)

43370 INVESTIGATION OF PROTON REACTIONS WITH TRITIUM AT ENERGY BELOW (p,n) REACTION THRESHOLD. Kuperin, A. B. Tr. Fiz. Inst., Akad. Nauk SSSR, 33: 3-65(1965). (In Russian).

An excited 20.3-Mev state in the alpha particle was found by studying the elastic scattering of protons on tritium at energies below the threshold of the (p,n) reaction over a wide region of angles sufficient to carry out a phase analysis. The 300- to 990-kev protons entered a chamber through a thin aluminum window that contained tritium gas at a low pressure of 2-8 mm Hg std. The scattered protons went through a thin Al window into special proportional counters filled with nitrogen at a low pressure of 4-18 mm Hg std. These precautions were necessary to reduce the effects of multiple scattering and absorption of the low-energy particles. A phase analysis of the experimental results was carried on a

computer. A unique solution corresponding to physical reality was obtained in the phase analysis. The results indicate that a virtual state with characteristics $J^{\pi} = 0^{+}$ exists in the alpha particle at an excitation energy of 20.3 ± 0.12 Mev. This excited state is essentially a single-particle one. The data on the excited state of the ^{4}He nucleus are compared with the results of other studies. (TTT)

43371 STUDIES OF ELASTIC SCATTERING OF CHARGED PARTICLES ON LIGHT NUCLEI AT LOW ENERGIES. Balashko, Yu. G. Tr. Fiz. Inst., Akad. Nauk SSSR, 33: 66-106(1965). (In Russian).

The D(t,α)n and D(^{3}He,α)p reactions were studied at low energies. Open counters (without an end window) were developed that could count 30-kev deuterons with 100% efficiency at a deuterium pressure of 2 to 5 Hg mm std. The target was a gaseous mixture of hydrogen and deuterium which was bombarded by a beam of tritium, ^{3}He, or deuterium ions to decrease the effect of multiple scattering. The impinging beam was analyzed with a magnet to separate out components having a different e/m value. Measurements taken to estimate the energy losses in the windows and in the gas target are described. The accuracy of measuring the energy of the charged particle was 1.5 to 2.5%. A correction is made for multiple scattering. The beam intensity was measured from the reaction yield accompanying the scattering. The results of measuring the differential cross sections of the elastic scattering of deuterons, tritons and ^{3}He on deuterium, and also of tritons on hydrogen were determined and compared with the calculated Coulomb cross section. The various sources of error are estimated. In the theoretical discussion, an attempt is made to determine the resonance parameters of the excited ^{5}He and ^{5}Li nuclei. A phase analysis was carried out for the elastic scattering of tritons on hydrogen. (TTT)

43372 AN ANALYSIS OF THE p-T REACTIONS AT ABOVE T(p,n)^{3}He REACTION THRESHOLD. Balashko, Yu. G.; Barit, I. Ya. Tr. Fiz. Inst., Akad. Nauk SSSR, 33: 107-22(1965). (In Russian).

The T(p,n)^{3}He reaction was analyzed for the existence of excited states in ^{4}He. The spin-orbital splitting contribution to the angular distribution of the elastic scattering was estimated by using only three parameters: an average angle $^{3}\delta$, a modulus of the scattering amplitude in the ^{3}P state, and a correction taking into account the reaction through the triplet P-states. On carrying out a phase analysis of the elastic scattering of the particles having spins, a single solution having physical significance was obtained by noting the phase behavior at low energies and threshold anomalies in the scattering cross section. However, even with the above procedure, it was necessary to make the following simplifying assumptions in order to proceed with the phase analysis: the contribution of partial waves with momentum $l > 2$ was small; there is only one resonance level in the singlet S-state; and there is no change in spin during elastic scattering or during reaction. The implications of these assumptions are discussed in detail. The results of the calculations become indefinite above 2.7 Mev and can not be used to predict the existence of a 20 Mev-level in ^{4}He. Only measurements of the elastic scattering cross section below the reaction threshold can indicate the existence of a level in the ^{1}S state. (TTT)

43373 INVESTIGATIONS OF INELASTIC SCATTERING OF 14-Mev NEUTRONS ON LIGHT OR MEAN-WEIGHT NUCLEI. Benetskii, B. A. Tr. Fiz. Inst., Akad. Nauk SSSR, 33: 123-57(1965). (In Russian).

The angular (n′,γ) correlation in the ^{12}C(n,n′γ)^{12}C reaction with 14-Mev neutrons was determined by measuring the neutron-gamma coincidences at different angles. The 4.43-Mev gamma from the 2^{+} to 0^{+} level in ^{12}C was measured on a scintillation counter. On comparing the angular (p′γ) correlation in the ^{12}C(p,p′γ)^{12}C reaction with the above data, it was noted that the same scattering mechanism is operative in both cases. This behavior is evidence for a direct interaction. The inelastic scattering cross section for 14-Mev neutrons in ^{24}Mg, ^{27}Al, ^{28}Si, and ^{56}Fe were determined by counting excited gamma transitions in these nuclei, and by comparing with the cross section of an (n,p) reaction in the same nucleus. The inelastic scattering cross sections σ(n,n′γ) in mb were found to be 590 for ^{24}Mg, 120 for ^{27}Al, 370 for ^{28}Si, and 660 for ^{56}Fe. The results are compared with literature values. A simple relation seems to exist between the total inelastic scattering cross section versus the mass number and the quadrupole moment of the nucleus. (TTT)

43374 NUCLEAR REACTION THEORY AND THE MANY-BODY PROBLEM. Vagradov, G. M. Tr. Fiz. Inst., Akad. Nauk SSSR, 33: 158-71(1965). (In Russian).

It is assumed that the hamiltonian for a system of colliding nucleons and nuclei is known, and contains the interaction potentials between the nucleons. No limitations are placed on the character of the interaction potentials which can be paired, ternary, repulsive, etc. The Pauli principle is applied to simplify the mathematics. Expressions are derived for such quantities as the general optical potential, scattering and reaction amplitudes, etc. These amplitudes can be presented in the form of a sum of two parts. One part determines the direct interaction, and the other part describes the processes taking place by way of a compound nucleus. In the particular case of an isolated resonance, the usual Breit-Wigner formula is obtained with an exact expression for the width and energy shift by means of matrix elements of the interaction potentials between nucleons. Investigating the limits of applicability of a particular nuclear model was illustrated for the inelastic scattering of nucleons on nuclei as an example. A qualitative comparison of theoretical and experimental data can be carried out to determine, for example, whether paired forces or ternary interactions are predominant. This analysis can give information on the parameters of the interaction within the nucleus. (TTT)

43375 QUANTUM-MECHANICAL BASIS OF THE NUCLEAR REACTION THEORY. Serdobol'skii, V. I. Tr. Fiz. Inst., Akad. Nauk SSSR, 33: 172-98(1965). (In Russian)

The formal theory of collisions between nucleons which uses integral operators and Green's functions is presented systematically and as completely as possible. The most important formulas necessary for calculation are derived. Since most nuclear reactions form an unstable compound nucleus and show definite resonances, a special formal theory of resonance nuclear reactions is necessary. The R-matrix theory of Wigner and Eisenbud is supplemented by a strict theory of resonance nuclear reactions, in which Green's functions for intermediate resonance states are expanded into series. All three types of nuclear reactions involving direct interaction, formation of a compound nucleus, and scattering can be satisfactorily described in a unitary fashion within the framework of a theory based on the use of Green's functions and integral operators. (TTT)

43376 APPLICATIONS OF A METHOD OF TIME-DEPENDENT CORRELATION FUNCTIONS FOR DESCRIBING PARTICLE INTERACTIONS WITH COMPLEX SYSTEMS. Kazarnovskii, M. V.; Stepanov, A. V. Tr. Fiz. Inst., Akad. Nauk SSSR, 33: 203-34(1965). (In Russian).

Van Hove showed that if scattering of particles or light quanta can be described by a Born approximation, the scattering can be interpreted by a space-time correlation function which is related to the differential cross section in a well-defined manner. The probability of interaction of any relatively simple particle used as a probe with a complex system is expressed by time correlation functions (TCF). The correlations have a simple form if the interaction of the probe particle with the complex system can be described by a distorted-wave approximation. It is shown that the Van Hove formula is general. Various kinds of probe particles and their interaction with a complex system can be distinguished only by the concrete form of an operator $\hat{T}(t)$. Various time correlation functions can be related to each other in a well-defined manner. The theory of the

shift and deformation of a Mössbauer line are described by TCF formalism. Time correlation functions can be used to describe the properties of complex systems which can be detected by probing the system with different kinds of radiation (neutrons, gamma rays, light quanta, charged particles, etc.). Thus, practically all the physically observable characteristics of complex systems can be correlated by this method. (TTT)

43377 ON THE POSSIBILITY OF INCREASING NUCLEAR REACTION YIELDS. Katsaurov, L. N.; Latysh, V. G. Tr. Fiz. Inst., Akad. Nauk SSSR, 33: 235-73(1965). (In Russian)

The number of nuclear reactions per second is $\phi = Ik$. Here I is the number of incident particles per second, and k is the utilization coefficient, or the number of reactions occurring per incident particle. The D-T, D-D reactions, and also the threshold p-T (threshold at 1019 kev) and p-^{7}Li (threshold at 1882 kev) reactions are used for the production of monoenergetic neutrons. The utilization coefficient for the D-T reaction is $k = 3 \times 10^{-5}$ and k has a value of about 10^{-7} for the threshold reactions. Thus, in principle, the utilization coefficient can be increased by many orders of magnitude. On working with small currents, the utilization coefficient can be improved by additional acceleration of the incident particles in a cyclotron with the use of thin targets or of gaseous targets. The yield with light nuclei can be increased by a factor of 10 to 15 and with average nuclei by a factor of 2 to 3. A small cyclotron with a three-sector magnet was designed to improve nuclear reaction yields. The cyclotron operates on externally injected 30-kev deuterons which are accelerated to 300 kev. The operation of the cyclotron with thin targets or with gaseous tritium targets is discussed. Design parameters are presented. (TTT)

43378 CORRELATION OF DIRECTIONS OF PAIR CONVERSION POSITRONS. Boldyshev, V. F. (Inst. of Physics and Tech., Khar'kov). Ukr. Fiz. Zh., 10: 697-707(July 1965). (In Ukrainian).

The correlation of emission directions of the photon and positron of pair conversion in a double cascade is considered, one of the transitions of which occurs with formation of electron-positron pairs. A general expression is obtained for the correlation function in the case of pure multipole transition of the electric and magnetic type. Pair conversion is considered in the Born approximation. (auth)

43379 ON THE EFFECTS OF THREE-PARTICLE FORCES IN ^{3}H AND ^{3}He. Shcherbin, Yu. P. (Leningrad State Univ.). Yadern. Fiz., 1: 935-6(May 1965). (In Russian).

Differential uni-dimensional equations are found for the wave function of two-nucleon and three-nucleon collisions. These equations can be formulated to calculate the binding energy and to explain the effects of three-particle interactions. The contribution to the binding energy from three-particle forces is calculated. It is assumed that a pair of nucleons ij interact with a virtual meson, and a pair of nucleons ik interact with a second virtual meson. A tentative function with a single variable is selected in the calculations. The binding energy ΔE depends strongly on the radius of the hard core x_0. With $x_0 = 0.4 \times 10^{-13}$ cm, the value of $\Delta E = 0.71$ Mev, and for $x_0 = 0.6 \times 10^{-13}$ cm the value of $\Delta E = 0.36$ Mev. Three-nucleon interactions can explain 10 to 15% of the observed binding energy of ^{3}H and ^{3}He. The calculations were carried out on a digital computer. (TTT)

43380 POSITRONS OF ^{171}Lu. Vitman, V. D.; Dzhelepov, B. S.; Efremova, V. Ya. (Mendeleev Inst. of Metrology, USSR). Yadern. Fiz., 1: 937-8(May 1965). (In Russian).

The ^{171}Lu was separated chromatographically after 20 hours from a hafnium fraction which in turn was obtained from a tantalum target irradiated with 660-Mev protons. The positrons were determined by counting $\gamma\gamma$ coincidences on a scintillation spectrometer. The ratio of the $\gamma\gamma$-coincidence count rates at angles of 180 and 90° was found to be: $N_{180}/N_{90} = 14 \pm 1$. The measurements were carried out over a period of 30 days. The positron activity decreased with a half life of 9.2 ± 1.1 days. The intensity of the 741-kev γ line belonging to ^{171}Lu decreased with a half life of 9.1 days. It is concluded that the positrons belong to ^{171}Lu. A comparison of the intensity of the positron radiation with the intensity of the 741-kev γ line of ^{171}Lu showed that $\beta^+/\gamma_{140} = 10^{-4}$. (TTT)

43381 SPECTRUM OF INTERNAL CONVERSION ELECTRONS IN THE NUCLEAR REACTION ^{128}Te(α,2n) ^{130}Xe. Chikhladze, V. L. Yadern. Fiz., 1: 1127-8(June 1965). (In Russian).

A tellurium target 98% enriched in ^{128}Te with a thickness of 6mg/cm^2 was bombarded with 22-Mev alpha particles. The target irradiation and analysis of the conversion electron by a double-lens beta spectrometer were carried out simultaneously. The internal conversion coefficients α_k were found to be 4.4×10^{-3} for the 416-kev gamma (γ_1), 2.3×10^{-3} for the 735-kev gamma (γ_2), 3.2×10^{-3} for the 663-kev gamma (γ_3), and 5.5×10^{-3} for the 536-kev gamma (γ_4). The sequence of excited levels in ^{130}Xe is presented. Since the transitions cascaded from one level to another, it was assumed that the excited levels are formed independently of each other with the same probability. The ratios of gamma intensities were $\gamma_1 : \gamma_2 : \gamma_3 : \gamma_4 = 15 : 37 : 66 : 88$. (TTT).

43382 ISOSPIN IN HEAVY NUCLEI. Sliv, L. A.; Kharitonov, Yu. I. (Ioffe Inst. of Physics and Tech., Leningrad). Yadern. Fiz., 1: 1129-31(June 1965). (In Russian).

An attempt is made to estimate the fraction of states with other isospins T contributing to the lowest isospin value T_0 for the ground state. The most realistic nuclear model and accurate approximations for the coulombic interaction are used. The coulombic potential for a particle in a field of Z particles is written. The wave function of the ground state of the nucleus is written that contains a term including all the transitions not accompanied by a change in isospin, and another term P estimating the admixture of states with other isospin T. The fraction of impurity from other states with isospin T increases with Z for light nuclei to Z = 20 (^{40}Ca), for which $T_0 = 0$. The use of isospin as a quantum number becomes meaningless for nuclei heavier than ^{40}Ca, since the isospin T_0 is greater than zero and increases with increasing mass number A. Thus, the fraction of impurity P remains about the same for all stable nuclei at 1 to 2%. This result can be extended to all the lower excited nuclear states. Higher isospin values T indicate excited nucleon states which are readily observed experimentally. (TTT)

43383 NEUTRON-PROTON INTERACTION AND NUCLEAR BINDING ENERGY. Hebach, H.; Kuemmel, H. (Max-Planck-Institut fuer Chemie, Mainz). Z. Physik, 186: 452-62(1965).

The effect of the neutron-proton interactions on nuclear binding energies B(N, Z) was investigated. Certain linear combinations of the B(N, Z) which can be interpreted as neutron-proton pairing energies were calculated for Sn and Sb isotopes and were compared with experimental data. The coupling constants are determined and some spins, parities and energies of levels of odd-odd nuclei are predicted. (auth)

43384 ON THE HYPERFINE STRUCTURE SPLITTING OF MOESSBAUER RADIATION IN TIME FLUCTUATION OF MAGNETIC FIELDS. Wegener, Horst (Universitaet, Erlangen, Ger.). Z. Physik, 186: 498-511(1965). (In German).

In magnetic materials, the time fluctuation of the atomic spin causes a fluctuation of the internal magnetic field H acting on the nucleus. The Mössbauer radiation in such materials suffers a magnetic hyperfine structure splitting, which displays the field fluctuation in a twofold way: an anomalous line broadening $\gamma(m_a m_g) = (\mu_a m_a/j_a - \mu_g m_g/j_g)^2 \cdot (\overline{H - H})^2 \tau_c$ and an anomalous line displacement $\delta(m_a m_g) = 2(\mu_a m_a/j_a - \mu_g m_g/j_g)^3 \cdot (\overline{H - H})^3 \tau_c^2/3$. The bar indicates the ensemble average value, μ and m, j are the magnetic mo-

ments and the spin quantum numbers of the nucleus in the excited and the ground state. $\tau_c \approx \tau_c'$ are atomic spin correlation times, well known from the treatment of the perturbed angular correlation technique. The formulas presented for $\gamma(m_a m_a)$ and $\delta(m_a m_a)$ are approximations obtained under the assumptions: the atomic spin Lamor precession is much faster than the Lamor precession of the nucleus, and the correlation time τ_c is not larger than the precession time of the nucleus. In many practical cases, both conditions are fulfilled. As an example, the Mössbauer spectrum of Fe $NH_4(SO_4)_2 \cdot 12\ H_2O$, investigated recently by the Oak Ridge group, is discussed in terms of the formulas presented. A data fit yields the Fe^{3+}-spin correlation times $\tau_c = 2.9 \times 10^{-9}$ sec and $\tau_c' = 2.3 \cdot 10^{-9}$ sec at temperatures $\leq 4.2°K$. (auth)

43385 RELATIVE MEASUREMENT OF ELECTRON POLARIZATION IN β DECAY: ^{199}Au AND ^{32}P. Loehken, Rudolf; Rebel, Heinigerd; Schatz, Gerd (Universitaet, Heidelberg). Z. Physik, 187: 1-5(1965). (In German).

The ratio of longitudinal polarization values of ^{199}Au and ^{32}P particles was measured by the method of double scattering. The result obtained is $P(^{199}Au)/P(^{32}P) = 0.83 \pm 0.05$ at 310 kev for the ground-state transition of ^{199}Au. (auth)

43386 ON THE NUCLEAR PHOTOEFFECT IN ^{40}Ar AND ^{38}Ar. Ehhalt, D.; Kosiek, R.; Pfeiffer, R. (Universitaet, Heidelberg). Z. Physik, 187: 210-20(1965). (In German).

Liquid argon was irradiated with bremsstrahlung from 18 to 31 Mev endpoint energy in steps of 2 Mev. The yields of the reactions ^{40}Ar $(\gamma,n) + (\gamma,p)$ and ^{38}Ar (γ,n) were measured by detecting the 269a and the 35d rest activity with a low-level-counter. Cross section curves for the (γ,n) processes could be found from the yield values, and they allowed, together with σ_{Np}, $\sigma(\gamma,p)$ and $\sigma(\gamma,np)$, a determination of $\sigma(\gamma,2n)$ and σ_{yabs} for ^{40}Ar. The integrated cross section for $\sigma(\gamma,n)$ from threshold to 33 Mev yields (200 ± 40) Mevmb for ^{40}Ar and (210 ± 40) Mevmb for ^{38}Ar, the corresponding value for σ_{yabs} being (450 ± 60) Mevmb for ^{40}Ar. (auth)

43387 PERTURBED DIRECTIONAL CORRELATION IN Ta-181 (thesis). Sommerfeldt, Raymond Walter. Corvallis, Ore., Oregon State Univ., 1965. 117p.

The effects of a static quadrupole interaction on the 133–482 kev gamma-gamma angular correlation in ^{181}Ta was studied by the delayed coincidence method. Using a source of ^{181}Hf in polycrystalline hafnium metal, the anisotropy was measured as a function of time between the formation and decay of the 482-kev state with a fast-slow coincidence spectrometer. The anisotropy as a function of time revealed clearly the periodic fluctuations arising from the reorientation of the nuclear spin due to coupling of the quadrupole moment of the 482-kev state with the electric field gradients of the hafnium crystals. The interaction strength evaluated on the basis of the theory of Abragam and Pound for axially-symmetric gradients was 317 ± 8 Mc/sec. Evidence for the presence of a rhombic (non-axial symmetric) electric interaction was observed in the departure of the results from the predictions of the axially-symmetric theory. The results are, however, in agreement with the theory for rhombic interactions if the electric field gradient in the hafnium crystals used is assumed to have an asymmetry parameter $\eta = (V_{xx} - V_{yy})/V_{zz} = 0.3$. A similar study of the 133–345 kev gamma cascade did not permit a direct observation of the quadrupole coupling due to interference from the 133–482 and 345–137 kev cascades; however, when the contributions of the interfering cascades were removed from the composite data, the results were consistent with those of the 133–482 experiment as well as with existing theory. An indirect determination of the anisotropy of the 345–137 kev cascade gave the value 0.32 ± 0.02 in agreement with a previous measurement. In addition, the half life of the 482-kev excited state was remeasured to be 10.4 ± 0.2 nanoseconds consistent with prior determinations. (Dissertation Abstr.)

43388 ABSOLUTE PHOTONEUTRON CROSS-SECTION MEASUREMENTS USING THERMAL-NEUTRON-CAPTURE GAMMA RAYS (thesis). Hurst, Robert Rowe. University Park, Penna., Pennsylvania State Univ., 1964. 85p.

Photoneutron cross-section measurements were made using various discrete-energy gamma rays emitted following thermal-neutron capture in different source materials. Precise measurements of the ^{181}Ta$(\gamma,n)^{180}$Ta cross section were made at several energies. These measurements, together with the well-known shape of the cross-section curve obtained using bremsstrahlung, provide a convenient standard which is used to obtain intensities for the various other monoenergetic gamma groups. The neutron yield was measured using a direct detection-type neutron counter consisting of an array of four BF_3 tubes mounted in paraffin, and surrounding the photoneutron target. An experiment was performed to study the relation between photoneutron cross sections and target mass numbers for gamma energies of 9.00, 9.72, and 10.83 Mev. These results suggest that structure may be present in the photoneutron cross-section curves of magic nuclei near threshold. Further measurements were made to determine the photoneutron cross sections of ^{165}Ho, ^{197}Au, ^{206}Pb, ^{208}Pb, and ^{209}Bi, between threshold and 10.83 Mev. ^{165}Ho and ^{197}Au exhibit no apparent structure in their cross-section curves. However, the ^{206}Pb$(\gamma,n)^{205}$Pb cross-section curve suggests that structure does exist, and the photoneutron curves of ^{208}Pb and ^{209}Bi clearly indicate sharp resonances are present, none of which have been previously reported for ^{209}Bi. (Dissertation Abstr.)

43389 THE POLARIZATION OF PROTONS FROM THE ^{3}He(d,p)^{4}He REACTION (thesis). Fann, Huoo-Long. College Park, Md., Univ. of Maryland, 1964. 124p.

Previous work on the polarization of protons from (d,p) reactions is briefly reviewed, both from an experimental and a theoretical point of view. An attempt is made to understand assumptions made in the distorted wave Born approximation, and the utility of polarization measurements in helping to interpret the interaction mechanism for deuteron induced stripping reactions. The polarization of protons from the ^{3}He(d,p)^{4}He reaction was studied at incident deuteron energies of 1.49, 2.06, and 2.63 Mev for outgoing proton angles between 30 and 150° in the laboratory system. The polarization of the scattered protons from the reaction was determined by measuring the left-right asymmetry of the elastically scattered protons from helium, employing the well-known double-scattering method. The target was a ^{3}He gas cell at 152 cm Hg. The polarimeter detected, in nuclear emulsions, protons scattered from ^{4}He gas at a pressure of 18 atmospheres. The effective analyzing power of the ^{4}He polarimeter was derived from a careful study of the proton-helium phase shifts. A proton polarization of $-21 \pm 4\%$ (Basel convention) was observed at a laboratory angle of 60° with an incident deuteron energy of 2.63 Mev at the center of the gas cell. For $E_d = 2.06$ Mev, the polarization shows a negative broad extremum near a laboratory angle of 60° and decreases to zero for backward angles. A measurement of the asymmetry of protons from the reaction at the resonance level of 430 kev shows that the analyzer's inherent asymmetry is less than 0.01. The inherent asymmetries due to finite geometry and possible misalignment of the experimental apparatus were calculated. These were found to give negligible correction to the measurements. (Dissertation Abstr.)

43390 A STUDY OF THE ^{14}N(^{14}N,^{13}N)^{15}N REACTION AT ENERGIES BELOW THE COULOMB BARRIER (thesis). Becker, Lawrence Charles. New Haven, Yale Univ., 1964. 155p.

An investigation of the ^{14}N(^{14}N,^{13}N)^{15}N neutron transfer reaction was conducted utilizing the nominally 1 Mev per nucleon ^{14}N-ion beam from the prestripper stage of the Yale heavy ion linear accelerator. The range and angular distribution of the ^{13}N reaction products were measured at a reaction energy of 6.1 Mev (cm). It was found that at least 87% of the reactions left the products in their ground states for an ejection angle of the ^{13}N of 20° (lab), and that

the absolute differential cross section varied from a maximum of 4.5×10^{-29} cm²/steradian at 26° (cm) to a minimum of 1.15×10^{-29} cm²/steradian at 87° (cm). The total cross section of the reaction was measured at energies ranging from 6.25 to 4.3 Mev (cm), and it was found to decrease with energy from 4.0×10^{-28} cm² at the highest energy to 2.0×10^{-30} cm² at the lowest energy. It was found that the rearrangement collision theory of Greider and the semi-classical tunneling theory of Breit and Ebel are in good agreement with the experimental relative differential cross section measurements, but that the tunneling theory of Breit and Ebel predicts a more rapid decrease in total cross section with energy than that which actually occurs. A calculation based on the tunneling theory of Breit and Ebel normalized to the high energy values of the measured total cross section led to a value for the reciprocal of the reduced width of the transferred neutron of 18 ± 1°F at a radius of 5.0°F. Using a simple square well model for the nucleus, it was found that a radius of 4.1°F (r_0 = 1.7°F) for the square well was needed for agreement between theory and experiment. (Dissertation Abstr.)

43391 CHARACTERISTIC RADIATIONS OF ^{93}Tc, ^{94}Tc, AND ^{90}Nb (thesis). Nwosu, Benjamin Chukuka Edeoghene. Columbus, Ohio, Ohio State Univ., 1964. 73p.

Molybdenum-92 enriched to 97.6% was submitted to 18-Mev ^{3}He bombardments for the first time. The gamma spectra of the reaction products were observed by means of scintillation spectrometry. Gamma rays in cascade were observed by means of a four-circuit coincidence unit as well as by a sum coincidence unit. The 2200-kev energy level in ^{93}Mo is populated by electron capture transitions from the 2.76-hour ^{93}Tc. The reported 2000-kev transition to ground state in the decay of ^{93}Tc was not substantiated. Two gamma transitions of energy 700 and 150 kev were included in a revised decay scheme of ^{93}Tc. The 150-kev transition was highly internally converted. A crossover gamma transition of 1430 kev was added to the decay scheme of 4.9-hour ^{94}Tc. Two other gamma rays of 230 and 340 kev, obtained from unscrambling and coincidence data, were included in the decay scheme of ^{94}Tc. The decay scheme proposed for ^{94}Tc is similar to the decay scheme of ^{92}Tc and is consistent with the shell model. Data obtained support the view that of the isomeric pair, the 4.9-hour ^{94}Tc is the ground state and not 52-minute ^{94}Tc as previously reported. The decay scheme of the 14.6-hour ^{90}Nb is revised. Fast sum-coincidence data obtained indicates that the lifetime of the 3580 kev energy level in ^{90}Zr is not 0.3 microseconds as previously reported, but is less than or equal to 44 nanoseconds. The inclusion of the 5450-, 5080-, 4450-kev energy levels in the decay scheme of ^{90}Nb was not confirmed. A new energy level of 3820 kev was introduced in the decay scheme of ^{90}Nb in order to account for the 1640-kev gamma ray which is in coincidence with the annihilation radiation, and for the 1130-kev gamma ray which is in coincidence with 240 kev gamma ray. Decay by positron emission in ^{90}Nb has a higher probability than electron capture—contrary to published data. Relative cross sections of the nuclear reactions (^{3}He,d), (^{3}He,p), (^{3}He,αn), and (^{3}He,α), observed when 18-Mev ^{3}He bombard ^{92}Mo, are hereby reported respectively as 700, 16.5, 15.2, and 3.5. A (^{3}He,αn) reaction, at a ^{3}He energy of 18 Mev, is also reported. (Dissertation Abstr.)

43392 NEUTRON TIME-OF-FLIGHT SPECTROSCOPY (thesis). Roush, Marvin Leroy. College Park, Md., Univ. of Maryland, 1964. 169p.

A measurement of the gamma-ray branching of the levels at 6.35, 6.90, and 7.50 Mev in ^{11}C is described. The states of ^{11}C were populated by the reaction ^{9}Be(^{3}He,n)^{11*}C and the resulting de-excitation gamma rays studied. Time-of-flight techniques were used to select neutron groups leading to states at 6.35, 6.90, and 7.50 Mev excitation in ^{11}C and gamma spectra recorded in coincidence with each individual group. The spectra were analyzed in terms of the major transitions present to obtain the following results: 6.35 → 0 (65 ± 5%), 6.35 → 2.00 (35 ± 5%), 6.90 → 0 (89 ± 3%), 6.90 → 4.32 (11 ± 3%), 7.50 → 0 (25 ± 5%), and 7.50 → 2.00 (75 ± 5%). It appears conclusive that these states in ^{11}C correspond to analog states in ^{11}B at energies of 6.81, 7.30, and 7.99 Mev, respectively, for which similar branching ratios were observed. The observed gamma-ray branching is consistent with J^π(6.35-Mev) = $\frac{1}{2}^+$, $\frac{3}{2}^+$ or $\frac{5}{2}^-$, J^π(6.90-Mev) = $\frac{3}{2}^+$, $\frac{5}{2}^+$ or $\frac{1}{2}^-$, and J^π(7.50-Mev) = $\frac{1}{2}^+$ or $\frac{3}{2}^+$. A comparison with the analog states in ^{11}B lends support for J^π(6.35-Mev) = $\frac{3}{2}^+$, J^π(6.90-Mev) = $\frac{5}{2}^+$, and J^π(7.50-Mev) = $\frac{1}{2}^+$ or $\frac{3}{2}^+$. The decay of the 7.50-Mev state is shown to indicate a nucleon configuration of $(1p_{\frac{3}{2}})^3(1p_{\frac{1}{2}})(1d_{\frac{5}{2}})$ and is also discussed in terms of clustering into ^{7}Be + α. The operation of the time-of-flight electronics is described briefly and circuit diagrams included for the major circuits. The time converter is based upon measuring the overlap time for pulses applied to the two control grids of a 6BN6. A time-of-flight fast neutron spectrometer for continuous beams of neutrons is described. A method for separating the scintillation signals from particles with different specific ionization is described which is relatively insensitive to signal amplitude. It is based upon a measurement of the zero-crossing time for signals produced by RC differentiation of dynode voltage pulses. The circuit utilizes the signal from a single photomultiplier dynode and operates satisfactorily at high counting rates. In the case of gamma-neutron discrimination in NE-213, excellent separation was observed over a range of amplitudes corresponding to recoil protons of 0.5 to 15 Mev energy. In addition, the pulse-shape sensing circuitry was used to separate small dynode signals due to low-intensity scintillations in NaI from phototube noise pulses of comparable amplitude. Calculations were made to select those circuit parameters which provide the optimum experimental ability to separate events due to two kinds of particles. Graphical displays of this optimization are shown for gamma-neutron discrimination in stilbene, NE-213, and NE-150 scintillators. (Dissertation Abstr.)

43393 NUCLEAR SPECTROSCOPY WITH HIGH ENERGY BORON IONS (thesis). Sachs, Martin William. New Haven, Yale Univ., 1964. 251p.

High energy boron beams were used in studies of proton and deuteron transfer reactions involving a carbon target. These studies, involving examination of reactions leading to isolated states in the residual nuclei, were undertaken to obtain information on the transfer mechanism at high energies, and to ascertain the extent to which such reactions might serve as probes for certain one- and two-nucleon states in the residual nuclei involved. The proton transfer reactions ^{12}C(^{11}B,^{10}Be)^{13}N and ^{12}C(^{10}B,^{9}Be)^{13}N, at bombarding energies of 115.5 and 105 Mev, respectively, were observed to populate only a few levels in ^{13}N. The first excited state, which is known to have a large proton reduced width, is not one of these levels. The deuteron transfer reaction ^{12}C(^{11}B,^{9}Be)^{14}N, at 115.5 Mev bombarding energy, was also observed to populate only a few levels in the residual nucleus, ^{14}N. Arguments are presented favoring direct population of ^{14}N levels having a ^{12}C + $(d_{\frac{5}{2}})^2$ two particle configuration. In particular, the observed strongly populated levels at 9.4 and 13.1 Mev excitation were tentatively identified as the J = 5, T = 0, and J = 4, T = 1 members of the above multiplet. The existing intermediate coupling calculations pertaining to ^{14}N are in excellent accord with such a description. The angular distributions of the strong groups in all reactions are smoothly varying, exponential functions of angle. On the basis of a sample calculation, it was concluded that they are not describable by a conventional plane wave stripping theory. A theory whose dominant interaction is the mutual scattering of the heavy cores was investigated and preliminary results are encouraging. It is also shown that heavy ion reactions are a more sensitive test of such a theory than are alpha particle induced reactions because the former involve larger ranges of linear momentum transfer. The apparatus used to obtain this data is also described. (Dissertation Abstr.)

43394 POLARIZATION OF PROTONS FROM THE ^{10}B(^{3}He,p)^{12*}C (4.43 Mev) REACTION (thesis). Simons, Donald George. College Park, Md., Univ. of Maryland, 1964. 143p.

Proton polarizations were measured for the $^{10}B(^3He,p)^{12*}C$ (4.43 Mev) reaction at ^3He energies of 2.5 and 2.8 Mev. These measurements were made for twelve angles from 0 to 135° at 2.5 Mev and for six angles from 15 to 75° at 2.8 Mev. The measurements at 2.5 Mev show that the polarization reaches a minimum of -0.36 ± 0.07 at $\theta_{lab} = 15°$ where the sign of the polarization follows the Basel Convention. At larger angles the polarization fluctuates and generally decreases. The angular dependence of the polarizations at 2.8 Mev is similar to those obtained at 2.5 Mev indicating a weak energy dependence in the energy range used. The polarizations were analyzed by scattering the protons from a plastic scintillator, using the known properties of the polarization of protons scattered by carbon. With the plastic scintillator, it was possible to reduce the backgrounds in the side detectors. This was done by identifying the scattered protons as coincidences between the 2nd scatterer and pulses of the proper energy in the side detectors. Geometrical errors obtained by machine calculations are included in the statistical errors. The indicated weak energy dependence is consistent with an interpretation of this reaction in terms of a direct reaction mechanism. Polarization signs and limits on $(^3He,p)$ reactions were derived using a spin-independent, stripping reaction model. These limits were applied to the results obtained in this measurement. It was concluded that, within assumptions of this model, the captured neutron-proton system from the ^3He nucleus can only be in a triplet state. Furthermore, the orbital angular momentum contributions of this deuteron are $l = 0$ and $l = 2$ where the maximum contribution from the $l = 0$ capture is 50%. The total angular momentum transfer from the $l = 2$ capture is primarily from $j = l + 1$. (Dissertation Abstr.)

43395 A STUDY OF THE $^7Li(^3He,n)^9B$ REACTION BY TIME-OF-FLIGHT TECHNIQUES (thesis). Dietrich III, Frank Sigel. Pasadena, Calif., California Inst. of Tech., 1964. 139p.

The $^7Li(^3He,n)^9B$ reaction was investigated at incident energies from 5.2 to 12.5 Mev, using a pulsed-beam time-of-flight spectrometer in conjunction with the ONR-CIT tandem accelerator. The spectrometer includes a pre-acceleration beam-bunching system, which increases the average target current by a factor of approximately 10 for protons and deuterons, and 4 for ^3He and alpha beams. Previously unreported ^9B levels were found at various energies. At 12.5-Mev bombarding energy, neutron groups corresponding to known ^9B states at 17.19 and 17.63 Mev were observed. No other ^9B states were resolved below 17.9-Mev excitation. The neutron groups were superimposed on an intense background continuum, attributable to processes leading to the final configuration $2\alpha + p + n$. An angular distribution at 8.7-Mev incident energy of neutrons leading to the 14.67-Mev state is roughly isotropic in the center-of-mass system, and the total cross section is 8 mb. A $T = 3/2$ assignment for the 14.67-Mev state is suggested by its narrow width, and by recent studies of the $^7Li(t,p)^9Li$ and $^7Li(^3He,p)^9Be$ reactions. A comparison of the $^7Li(^3He,p)^9Be$ and $^7Li(^3He,n)^9B$ reactions showed that the cross sections for formation of the 14.67-Mev ^9B state and the analogous ^9Be state are approximately equal, if barrier-penetration effects in the outgoing channels are removed. (Dissertation Abstr.)

43396 DETERMINATION OF THE ENERGY LEVELS AND BRANCHING RATIOS IN ^{17}N USING MULTI-PARAMETER ANALYSIS (thesis). Hart, Vincent Paul. Iowa City, Iowa, Univ. of Iowa, 1964. 84p.

The nuclear reaction $^7Li + ^{11}B$ was studied with the use of a three parameter analysis technique. The three parameters recorded were particle type, particle energy, and energy of gamma rays in time coincidence with the charged particles. Both ungated particle spectra and particle-gamma coincident data were taken simultaneously. Particles were detected by a $E-dE/dX$ system made up of solid-state detectors. The gamma rays were detected in a large NaI(Tl) crystal. The data gathering and analyzing system consisted of three pulse-height analyzers (256 channels for E_γ and ΔE, and 1024 channels for E_p) and a small general purpose computer with magnetic tape units and an oscilloscope display. The energies of protons from the reaction $^{11}B(^7Li,p)^{17}N$ were measured. Groups corresponding to previously observed states in ^{17}N were seen as well as to 14 new states. Spectra of gamma rays from the bound levels of ^{17}N were analyzed to give the decay schemes and some branching ratios. Calibrations were obtained from gamma rays of known energy produced in the reaction and from the known energies of some of the proton, deuteron, and triton groups. (Dissertation Abstr.)

43397 CORRELATED ENERGY AND TIME-OF-FLIGHT MEASUREMENTS OF FISSION FRAGMENTS (thesis). Kiker, William Edward. Knoxville, Tenn., Univ. of Tennessee, 1964. 94p.

Correlated energies and velocities of single fission fragments from the spontaneous fission of ^{252}Cf were measured. Absolute calibrations of energies and times-of-flight were obtained with estimated accuracies of ±0.3% from direct comparison measurements with 30- to 120-Mev ^{79}Br, ^{81}Br, and ^{127}I ions from the Tandem Van de Graaff accelerator. The post-neutron-emission kinetic parameters obtained were compared with the pre-neutron-emission quantities obtained from the double time-of-flight experiments of others. Of special interest is the fine structure which appears in the post-neutron-emission mass distribution. It is shown that this structure reflects the fine structure observed in the pre-neutron-emission mass distribution, which in turn reflects certain energetically preferred even-even fragment configurations of ^{252}Cf spontaneous fission. Within the 2.5 per cent mass resolution of the present experiment, no additional fine structure appears as a result of neutron boil-off to specific fragment masses. The number of neutrons $\nu(M)$ as a function of fragment mass was calculated from the pre- and post-neutron-emission mass distributions. A universal calibration procedure for solid-state detectors for fission fragments is suggested; this procedure is based on the present absolute fragment energy determinations and takes into account the mass dependence of the pulse-height vs energy relation. (Dissertation Abstr.)

43398 THE MECHANISM OF THE Si(d,p) REACTIONS BELOW 3 Mev (thesis). Wildenthal, Bryan Hobson. Manhattan, Kan., Univ. of Kansas, 1964. 76p.

The $^{28}Si(d,p)^{29}Si$ and $^{30}Si(d,p)^{31}Si$ reactions were studied in the deuteron energy range from 2 to 3 Mev. Excitation functions for the reactions leading to various final states were obtained at 30 and 135° in the laboratory system. The differential cross sections exhibited fluctuations from 40 to 200 kev wide which were uncorrelated between the two angles of measurement and between the various final states of a nucleus. Angular distributions and the resulting total cross sections were obtained at fourteen deuteron energies. These data fluctuated significantly over short energy ranges. DWBA predictions were fitted to the experimental distributions with reasonable success for the $l_n = 0$ and 1 transitions and with less conclusive results for the $l_n = 2$ transitions. These theoretical predictions were used as the basis of estimating the relative importance of compound nucleus and direct interaction reaction mechanisms in this energy range. The possibility of explaining the observed fluctuations in terms of the Ericson fluctuations of the compound nucleus reaction component was explored. The transition to the sixth excited state (3.54 Mev) of ^{31}Si was assigned the value $l_n = 1$. (Dissertation Abstr.)

43399 ENERGY-MASS DISTRIBUTIONS AND ANGULAR MOMENTUM EFFECTS IN HEAVY-ION-INDUCED FISSION (thesis). Plasil, Franz. Berkeley, Calif., Univ. of California, 1964. 134p.

Measurements were made of the energy and mass distributions of fission fragments produced by the bombardment of a number of relatively light elements with heavy ions. The results were interpreted in terms of an approximate version of the liquid-drop model which applies to this region of elements. The energies of both fission fragments

from every event considered were measured with solid-state detectors and were recorded in a correlated manner. The energy data are transformed to give mass-total kinetic energy density-of-events distributions. The reactions studied were: $^{170}Er + {}^{16}O = {}^{186}Os$, $^{174}Yb + {}^{12}C = {}^{186}Os$, and $^{182}W + {}^{16}O = {}^{198}Pb$. Data at several bombarding energies in each case are obtained. Comparisons with quantitative liquid-drop calculations were made, and good agreement was found in the gross features of the distributions and in the nuclear temperature dependence of the widths. Fission cross sections were calculated by evaluating fission widths and were fitted to measured cross-section data. From the parameters used in these fits, average values for the nuclear temperature of the fissioning nuclei were obtained. The fission barriers needed for these calculations were obtained from calculated energies of deformation of rotating charged liquid drops in their equilibrium configurations. (Dissertation Abstr.)

43400 TRINUCLEONS AND VELOCITY-DEPENDENT POTENTIALS (thesis). Srivastava, Balkrishna. Ithaca, N. Y., Cornell Univ., 1964. 80p.

The trinucleons ^3H and ^3He with a two-body central velocity-dependent potential both in ^1S and ^3S states were studied. In particular an attempt was made to determine a suitable wave function to describe the trinucleons and a two-body central velocity dependent potential in ^1S and ^3S states which will give the bare form factor of the trinucleons, the binding energy of the triton, the Coulomb energy of ^3He, the integrated cross section (σ_{int}), and the bremsstrahlung-weighted cross section (σ_b) for the triton in reasonable agreement with experimental results and with results from similar calculations using hard core potentials and wave functions. The two-body central velocity-dependent potentials in ^1S and ^3S states used in the variational calculation are given by $v_s = -100 \exp(-1.25r) + 2/M[p^2 \exp(-2.8r) + \exp(-2.8r)p^2]$ and $v_t = -184 \exp(-1.25r) + 1.1/M[p^2 \exp(-2r) + \exp(-2r)p^2]$, respectively. The binding energy of the triton was found to be 7.17 Mev for $\kappa = 0.732\ F^{-1}$, $\lambda = 1.415\ F^{-1}$, and $A = -1.305$. The corresponding value of the Coulomb energy of ^3He is 0.663 Mev. The calculation for the bare form factor of the trinucleons with the wave function ψ_2 using the values of κ, λ, and A given above give results in reasonable agreement with experiments of others. This shows that the shape of the wave function ψ_2 is quite good. Finally σ_{int} and σ_b with ψ_2, v_s, and v_t were calculated. The values of the parameters κ, λ, and A obtained from the variational calculation were used. Again the agreement with experimental values and theoretical values using hard core potentials and wave functions was quite satisfactory. Thus it was concluded that ψ_2 is quite a good wave function for the description of the trinucleons. Also v_s and v_t are satisfactory two-body central velocity-dependent potentials in ^1S and ^3S states respectively. (Dissertation Abstr.)

43401 PHOTON SCATTERING CROSS SECTIONS BELOW THE PHOTONEUTRON THRESHOLD FOR ^{206}Pb, ^{208}Pb, AND ^{209}Bi (thesis). Stein, Nelson. Urbana, Ill., Univ. of Illinois, 1964. 217p.

The elastic scattering of photons was measured as a function of energy below the (γ,n) threshold. A bremsstrahlung monochromator was used to provide nearly monoenergetic photons of energy resolution between 1 and 2%. Cross sections were obtained for ^{208}Pb between 5.9 and 8.2 Mev, for ^{208}Pb between 6.6 and 7.5 Mev, and for ^{209}Bi between 5.1 and 7.7 Mev. In all three cases, structure and sharp fluctuations with energy were observed. The ^{208}Pb cross section contains three strong peaks centered at 6.72, 7.03, and 7.29 Mev. Each peak is consistent with the experimental resolution and is most likely dominated by a single strong level whose width is much less than the resolution. The quantity $\Gamma_0^2/\Gamma(\Gamma$ and Γ_0 are the total and ground state radiative widths) for each peak is 14 ± 7 ev at 6.72 Mev, 30 ± 13 ev at 7.03 Mev, and 41 ± 10 ev at 7.29 Mev. Additional resonant absorption measurements indicate that Γ_0/Γ is very close to 1. The widths associated with the structure in ^{206}Pb and ^{209}Bi were generally greater than the resolution. In ^{206}Pb a well defined resonance about 400 kev wide is centered at 7.85 Mev with a peak cross section of 20 mb. Another maximum occurs at 7.45 Mev, and further structure superimposed on a generally decreasing cross section is suggested as the energy decreases. In ^{209}Bi the scattering strength is concentrated into two large peaks with maximum cross sections of 21 and 27 mb at 5.5 and 7.3 Mev, respectively. Separating the peaks is a broad valley in which the average cross section is about $1/7$ of the observed maxima. In contrast with ^{208}Pb, the structure observed in the ^{206}Pb and ^{209}Bi cross sections represents the average contribution from many unresolved narrow levels included within the resolution. Resonant absorption measurements indicate that at 7.3 Mev in ^{209}Bi the average spacing, D, between levels having the ground state spin is about 1.5 kev, and the average radiative width, $\overline{\Gamma_0}$, to the ground state is about 0.2 ev. Estimates at 7 Mev for ^{206}Pb indicate approximately similar values. The results provide lower limits for the photon absorption cross sections below the (γ,n) threshold; for ^{208}Pb, upper limits are also given. Similarities among the three nuclei, both in scattering and in the photoneutron cross sections just above the threshold, suggest the likelihood that the observed photon strength involves primarily the ^{208}Pb core. The magnitude of the total strength observed throughout the threshold region is consistent with the two estimates of electric dipole strength that are closely related to the giant dipole resonance. (Dissertation Abstr.)

Plasma Physics and Thermonuclear Processes

Refer also to abstract 43217.

43402 (AD-609728) INDUCTIVE PLASMA ACCELERATION RESEARCH. Final Report. Gates, D. C.; Demeter, L. J.; Day, W. B.; Wyatt, J. L. (Aerojet-General Nucleonics, San Ramon, Calif.). Dec. 1964. Contract AF33(657)-10979. 150p. (APL-TDR-64-97; AN-1238). CFSTI $4.00 cy, $1.00 mn.

A transmission-line type of inductive plasma accelerator utilizing distributed charge exchange is discussed. A diagnostic system capable of rapidly performing measurements of the flux and angular and energy distributions of the ions and neutrals that are accelerated and expelled from the transmission line is discussed. The diagnostic system is in two parts: the detector section and the calibration section. The design, construction, testing, and calibration of both the detector and the calibration section are described. (M.O.W.)

43403 (ARL-65-95) TEMPERATURE DETERMINATION IN MODERATELY DENSE, HIGH-TEMPERATURE GASES BY TRANSIENT THERMOCOUPLE PROBES. Tschang, P. S. (Columbia Univ., New York. Electronics Research Labs.). May 1965. Contract AF33(615)-1141. 39p. CFSTI.

A study was made to determine the bases of the transient methods of the single probe, the dual-probe, and the intermittent probe for measuring high gas temperatures. Simple parameters critically affecting the probe accuracies were singled out for comparing the relative merits of the methods under scrutiny. The results indicate no fundamental superiority of any one technique, but in practice the single probe seems most likely to attain the theoretical accuracy by virtue of its simplicity of implementation. The analyses indicate the need to take the variation of all probing parameters into account because of the tendency for these effects to be magnified into large errors resulting in inaccurate gas temperature determination. A novel three-terminal low noise thermocouple sensing element is presented together with its performance in an arc plasma environment. (auth)

43404 (ARL-65-120) A BIBLIOGRAPHY ON MOVING STRIATIONS. Palmer, R. S.; Garscadden, A. (Aerospace Research Labs., Wright-Patterson AFB, Ohio). June 1965. 24p.

A brief summary of present research and a bibliography (229 references) concerning moving striations in low-pressure (~1 torr) gaseous discharges is presented. Chronological order highlights the recent work. (auth)

43405 (GA-6441) A METHOD TO USE A COMPUTER TO EVALUATE LANGMUIR PROBE DATA FOR OBTAINING THE ELECTRON TEMPERATURE. Eggers, G. H.; Schwirzke, F. (General Atomic, San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science). June 4, 1965. 15p. (CONF-650512-1).

From Symposium on Engineering Problems of Controlled Thermonuclear Research, Livermore, Calif.

A method is described for computer analysis of data produced by Langmuir probes in plasma. The method provides rapid calculations of the electron temperatures in the plasma. (T.F.H.)

43406 (IAE-587) IZUCHENIE SVOISTV BYSTRO DVIZHUSHCHIKHSYA PLAZMENNYKH SGUSTKOV. (Study of the Properties of Fast-Moving Plasma Bunches). Demichev, V. F. (Institut Atomnoi Energii, Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1964. 30p. Dep. mn.

Experiments on the properties (velocity, energy, and momentum) of plasmoids produced in an electrodynamic injector of the coaxial type are considered. The injector was of the type described by D. Marshall (Physics of Fluids 3: 134(1960)), 24 cm long, with inside and outside diameters 32 and 75 mm, respectively. The injector construction and operation are described. The plasmoid longitudinal velocity was measured by several methods (magnetic probe, measurement of diamagnetic properties of the plasma, photomultipliers). The energy was measured by a calorimetric method. The integral momentum of the plasmoid was determined by measuring the initial speed of a ballistic pendulum (deep cylindrical vessel moving together with the calorimeter). The composition of the plasma was determined by a spectroscopic method. The energy loss due to the interaction between the plasmoids and the metallic surfaces of the apparatus was estimated by a calorimetric method. When working with hydrogen and deuterium, the attainable plasma speed could be varied between 2×10^6 and 8×10^7 cm/sec by varying the initial voltage or pressure of the injector or by varying the delay time. As a rule, two plasmoids were produced in each injection, the first several times faster than the second. In some cases the first plasmoid split into two, the front section carrying an appreciable fraction of the energy. The maximum plasmoid energy produced in one discharge exceeded 2000 J, and the maximum attainable momentum reached 2000 dyne-sec. The plasmoid dimensions could reach 20×100 cm, and the density could be varied from 10^{13} to 5×10^{15} cm^{-3}. The number of particles in the plasmoid could reach 2×10^{19} and their conductivity reached 10^{14} cgs esu. Not all the energy was transferred to the walls in the case of plasma-metal interaction, energy reflection similar to a shock wave taking place, reaching 75% of the incident energy under some conditions. (ATD)

43407 (IAE-855) O DISKRETNYKH SOSTOYANIYAKH PLAZMENNOGO PUCHKA I PEREKHODAKH MEZHDU NIMI. (On Discrete States of a Plasma Bunch and Transitions Between Them). Nezlin, M. V.; Solntsev, A. M. (Institut Atomnoi Energii, Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1965. 16p. Dep. mn.

It is known that a plasma beam, consisting of a column of cold plasma and a current of fast electrons penetrating this column, changes from a macroscopically stable state into a state with a virtual cathode when the ratio of the densities of the two components is decreased. The character of this transition was investigated experimentally. It was shown that it occurs by means of two jumps, during which the energies of the plasma particles, the oscillation frequencies, and the radial dimensions of the beam and its potential increase significantly. These developments of instability of the beam are maintained in unchanged form also in the case when the velocity distribution function of the fast electrons loses all orderliness. (tr-auth)

43408 (IPPJ-33) EFFECTS OF A MAGNETIC FIELD ON ELECTRON PROBE CURRENTS. Sugawara, Minoru; Hatta, Yoshisuke (Institute of Plasma Physics, Univ. of Nagoya (Japan)). June 1965. 10p. Dep. mn.

An experimental study is presented of the electron saturation currents arriving at a plane probe situated in a plasma in a magnetic field. Ratios of the electron saturation current collected by a disc-shaped probe parallel and perpendicular to the magnetic field were measured with two probes. Many measurements showed that these ratios decrease slowly with increasing $\psi_e = \omega_e \tau_e$ and that the curves moved to an increasing ψ_e range as the gas pressure was decreased, indicating that electrons were flowing to the probe by diffusion. Ratios of $I_{e\perp}$ and $I_{e\parallel}$ to the electron probe current in no magnetic field (I_{e0}) were also measured. Among these three curves the curve of $I_{e\perp}/I_{e\parallel}$ exhibits the most slow decrease, and the curve of $I_{e\parallel}/I_{e0}$ exhibits the sharpest decrease at the same gas pressure; i.e., with increasing magnetic field. It seems clear that the effect of the magnetic field on the electron diffusion is the most important factor, as far as electron collection is assumed to be controlled by the need for the compensation by diffusion of the electrons depleted by the probe. (auth)

43409 (IPPJ-34) INTERNAL PLASMA RESONANCE OF POSITIVE COLUMN NEAR ELECTRON CYCLOTRON HARMONIC FREQUENCIES. Tanaka, Shigetoshi (Institute of Plasma Physics, Univ. of Nagoya (Japan)). June 1965. 35p. Dep. mn.

A series of subsidiary resonance peaks observed near the electron cyclotron harmonics is studied by the measurements of microwave radiation from a positive column in a magnetic field. When an external microwave is applied to the plasma column to heat plasma electrons, an intensity of subsidiary resonance peaks increases extremely and also a number of their peaks increases. Further, their dispersion curves displace toward a higher magnetic field and toward a higher electron density, compared with those when there is no heating power. The experimentally observed behavior of these peaks can be explained from the fact that a series of subsidiary resonance peaks is resulted from the internal plasma resonance due to the standing plasma waves within the propagating region of the plasma column. (auth)

43410 (IPPJ-35) ENHANCEMENT OF CYCLOTRON HARMONICS IN A HOMOGENEOUS MAGNETOPLASMA. Sugihara, Ryo (Institute of Plasma Physics, Univ. of Nagoya (Japan)). May 1965. 13p. Dep. mn.

A theoretical investigation is made of the radiation from a point charge (e) gyrating in a plane perpendicular to a magnetic field. The velocity (v) of the charge is assumed to be non-relativistic but much larger than the thermal velocity v_T, $\ln(v/v_T) \gg 1$. Under the conditions $|\epsilon_1| \gg (sv_T/v)^{4s-3}$, $\epsilon_3 \gg (V_T/sv)^2$, and $\omega_0^2 < \omega_r^2 = (s\omega_H)^2 < \omega_0^2 + \omega_{Hp}^2$ the intensity of the s-th harmonic is enhanced and given by $(2e^2\omega_r^2/\pi s_v\sqrt{|\epsilon_1\epsilon_3|})\ln(v/v_T)$. Here ω_0 and ω_H are the plasma frequency and the electron cyclotron frequency, respectively, s is a positive integer larger than unity and $\epsilon_1 = 1 - \omega_0^2/(\omega_r^2 - \omega_H^2)$, $\epsilon_3 = 1 - \omega_0^2/\omega_r^2$. A harmonic structure appears when ω_H or ω_0 is changed. (auth)

43411 (IPPJ-36) ELECTRICAL CONDUCTIVITY OF A PLASMA IN IDEAL TURBULENCE. Kihara, Taro (Institute of Plasma Physics, Univ. of Nagoya (Japan)). June 1965. 9p. Dep. mn.

Weak turbulence in a fully ionized plasma is called ideal turbulence when the time of relaxation of non-Maxwellian velocity distribution of the electrons is much shorter than the corresponding relaxation time in a quiescent state. In the ideal turbulence the electric conductivity for the frequency ω small compared with the plasma frequency is calculated to be $ne^2/m(\Omega - i\omega)$ in which $\Omega = (4/3)n_i(2\pi T/m)^{\frac{1}{2}}(Ze^2/T)^2[\ln(4T/\gamma^2Ze^2k_{12}) - (1/2)]$. Here m is the electron mass; -e and n are the charge and number density of the

electron; Ze and n_i are those of the ion; T is the temperature in energy units; and ln γ = 0.577 is Euler's constant. (auth)

43412 (IPPJ-38) ELECTRON ACCELERATION IN PLASMA WAVE EXCITED BY RESONANCE PROBE. Uramoto, Johsin; Takayama, Kazuo (Institute of Plasma Physics, Univ. of Nagoya (Japan)). June 1965. 18p. Dep. mn.

Another sort of peak, in the d-c current component of the resonance probe, is observed when the plane probe is set across a plasma beam (neutralized ion beam) produced by the back diffusion type mercury discharge. The d-c peak is different from the ordinary sheath resonance and appears at a frequency higher than that frequency. A discharge tube for producing the plasma beam contains an electron injection region in the opposite boundary against the plane probe. The d-c peak depends on plasma beam density, applied r-f signal voltage, length between the resonance probe and the opposite boundary, and pressure. It is remarkable that the d-c peak frequency corresponds to a frequency where the r-f current component shows a minimum, while the ordinary sheath resonance peak frequency also corresponds to a frequency where the r-f current component shows a maximum. Therefore, the d-c peak is considered to appear at the electron plasma frequency and to result from the synchronous acceleration of electrons injected into the plasma wave excited one-dimensionally in the plasma beam by the resonance probe. (auth)

43413 (LA-3253(Rev.)) REVIEW OF CONTROLLED THERMONUCLEAR RESEARCH AT LOS ALAMOS, 1965. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). Apr. 1965. Contract W-7405-eng-36. 107p. Dep. mn; CFSTI $4.00 cy, $0.75 mn.

The past history, present status, and future plans of the Los Alamos Scientific Laboratory Sherwood program are discussed. A case is presented for pulsed high-density high-β plasmas as a promising route to power producing thermonuclear reactions. A proposal for a closed toroidal theta-pinch experiment (Scyllac) is given. Preliminary plans are also given for a closed flute-stable system—the Caulked Cusp. (auth)

43414 (LA-3334) A MEASUREMENT OF THE ELECTRON DENSITY OF THE DENSE PLASMA FOCUS BY SCHLIEREN PHOTOGRAPHY. Mather, J. W. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). May 14, 1965. Contract W-7405-eng-36. 10p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

The Schlieren method employing a pinhole aperture is used to determine the electron density of a dense plasma. An expression is derived for the mean angular divergence (Θ) of a parallel light beam in terms of the refractive index, the gradient of refractivity, and the boundary shape factor of the plasma. This calculation is applied to the dense plasma focus experiment for a specific electron density distribution and plasma shape. The Schlieren method gives a least value of 10^{19}/cc, in good agreement with other independent measurements (2×10^{19}/cc). (auth)

43415 (MATT-347) RADIOLOGICAL SAFETY MEASUREMENTS OF X RAYS AND NEUTRONS FROM PULSED SOURCES. Miller, H. L. (Princeton Univ., N. J. Plasma Physics Lab.). July 1965. Contract AT(30-1)-1238. 21p. (CONF-650512-7). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Symposium on Engineering Problems of Controlled Thermonuclear Research, Livermore, Calif.

Monitors were developed for continuous, unattended recording of radiation dose at rates ranging from steady state near natural background to extremely high intensity at low duty cycle. The gamma and x-ray monitors were built in two forms, one as a self-contained unit with its own recorder and the other as a remote area monitor system that takes information from a number of remote locations and feeds it into a central multipoint recorder. The gamma and x-ray monitors were designed to operate with x-ray pulses as intense as 8,000,000 mrem/hr for 100 μsec, or proportionately longer at lower intensity. The neutron monitor was built as a remote unit, interchangeable in the system with the x-ray monitors. It is based on the Bonner Sphere, but the maximum counting rate limitations characteristic of other versions of this instrument were improved by a factor of 10 by use of delay line shaping to shorten the photomultiplier output pulse to 0.3 μsec. A 0.3 μsec pulse results in a 10% coincidence loss at 267,000 mrem/hr. (auth)

43416 (NP-15219) SVERKHZVUKOVAYA STRUYA VODORODA V VAKHUUME. (A Supersonic Jet of Hydrogen in a Vacuum). Yuferov, V. B.; Kovalenko, V. A.; Skibenko, E. I.; Busol, F. I. (Akademiya Nauk Ukrainskoi SSR, Khar'kov. Fiziko-Tekhnicheskii Institut). 1964. 5p. Dep. mn.

A cryogenic technique used to create supersonic CO_2, Ar and N_2 streams was applied to hydrogen. The surface on which condensation of hydrogen took place was cooled with liquid helium. The heat flux at the helium-cooled surfaces was 10^{-2} to 10^{-3} watts/cm^2. The arrangement of the nozzle with respect to the condenser, the direction of the hydrogen jet, shape of the condenser, and experimental apparatus are described in another report. The thickness of the hydrogen jet was determined by the extent of conversion of an ion beam to a neutral beam. With 25 kev hydrogen ions the optimum thickness was attained at a hydrogen flow of 45 to 50 cm^3/sec. The pressure P_k in the neutralization chamber was an order of magnitude higher with the hydrogen jet than it was with the CO_2 and Ar jets. Special measurement showed that the reason for the above behavior was a significant temperature drop between the liquid helium and the surface of the condenser. The source of heat supply to the condenser was radiation from the walls which were at room temperature. The temperature drop was 0.45°K. The performance could be improved with proper insulation. As the hydrogen flow rate was increased from 10 to 80 cm^3/sec the pressure in the charge exchange chamber increased from 2.5 to 9×10^{-5} mm Hg. The supersonic hydrogen stream can be used for the injection of a fast neutral hydrogen or deuterium beam into a hot plasma. See also NSA 19: 6445, 6446, 16411. (TTT)

43417 (NP-15288) DIFFUSION MEASUREMENTS IN A FULLY IONIZED CESIUM PLASMA (thesis). Report No. 18. Eastlund, Bernard J. (Columbia Univ., New York. Plasma Lab.). [1964]. 160p.

Pulses of potassium plasma were launched at the end of a quiescent, steady state, fully ionized cesium column. The shape of this pulse was measured as it drifted along the cesium column. Values of the diffusion coefficients for both parallel ($D_{||}$) and perpendicular ($D_\perp$) diffusion in a magnetic field were obtained. The experimental values for $D_{||}$ agree very well with the Chapman-Enskog solution of the Boltzmann equation. Experimental values obtained for $D_\perp$ do not agree with present theoretical predictions. It is observed that $D_\perp$ appears to be inversely proportional to the particle number density, while classical theory predicts direct proportionality. Free molecular flow experiments were carried out and found to agree well with classical kinetic theory. (auth)

43418 (NP-15357) SOME EXPERIMENTAL OBSERVATIONS OF THE ATTENUATION OF ALFVEN WAVES IN A LABORATORY PLASMA. Brown, Ian G. (Sydney Univ. (Australia). School of Physics). May 1965. 26p. (ER-15). Dep. mn.

An experiment is described in which the velocity and attenuation of torsional, azimuthally symmetric hydromagnetic waves are measured in a hydrogenous plasma, from low frequencies where ion-neutral collisions are unimportant to the wave damping, to frequencies where such collisions profoundly affect the damping. A theory including both ion-electron and ion-neutral collisions is outlined, and the attenuation results compared to the theoretical values. An estimate is made, from the frequency dependence of the attenuation, of the hydrogen ion-atom collision cross section for momentum transfer. (auth)

43419 (BNL-tr-7) VALIDITY OF MEASUREMENT OF ELECTRON TEMPERATURE IN A FLAME BY MEANS OF LANGMUIR PROBES IN CONTACT WITH A COLD WALL.

Ahrabi, Rahim; Klein, Siegfried. Translated by Stephen Amoretty (Brookhaven National Lab., Upton, N. Y.) from Compt. Rend., 258: 3228-31(Mar. 23, 1964). 6p. Dep. mn; JCL $1.10 fs, $0.80 mf.

The results of measuring the electron temperature in a flame (illuminating gas by air) by means of electrostatic probes with internal water circulation are presented. A comparison of results of electron temperature measurements taken by a hot electrode near a cold wall is made with results from the cold electrode. (M.O.W.)

43420 THE INFLUENCE OF A MAGNETIC FIELD, PARALLEL TO THE CATHODE, ON THE SECOND CATHODE SHEATH OF A LOW-PRESSURE ARC DISCHARGE. Warmoltz, N. (Philips' Gloeilampenfabrieken, N. V., Eindhoven, Netherlands). Appl. Sci. Res., Sect. B, 11: 418-22(1964-1965).

The influence on the second sheath of a magnetic field, directed parallel to the indirectly heated cathode of a low pressure gas discharge is described. The phenomena are in accordance with the existing picture of the discharge mechanism, based on beam-plasma space-charge interaction. (auth)

43421 ON THE PROPAGATION OF SPHERICAL WAVES IN NON-LINEARLY IONIZED GASES. De Socio, Marialuisa. Atti Accad. Sci. Torino: I. Classe Sci. Fis., Mat. Nat., 99: 617-36(1964-65). (In Italian).

The propagation of a spherical electromagnetic wave in an ionized gas, particularly the variation of the discontinuity of the field and of its derivatives on the wave front, are studied. The effects that the non-thermal terms exercise on such discontinuities are not considered, and it is assumed that the interaction between the gas particles can be neglected. Such influence remains zero for the magnetic field while it is evident for the electric field, but in a form that is generally negligible and only begins at the discontinuity of the fifth derivative. (tr-auth)

43422 EQUILIBRIUM OF A PINCH DISCHARGE WITH A TRANSVERSE ROTATING MAGNETIC FIELD. Blevin, H. A.; Miller, R. B. (Univ. of New England, Armidale, New South Wales). Australian J. Phys., 18: 309-15(Aug. 1965).

The electron density distribution in a linear pinch discharge with a transverse rotating magnetic field is calculated for partially ionized plasmas. Numerical examples are given for distributions in the plasma with and without externally applied axial magnetic fields, and with different degrees of ionization. (auth)

43423 KINETIC CURRENT INSTABILITY OF ALFVEN WAVES IN A PLASMA WITH FINITE ION LARMOR RADIUS. Mikhaylovskii, A. B.; Pashitskii, E. A. (Inst. of Atomic Energy, Moscow). Dokl. Akad. Nauk SSSR, 161: 81-3 (Mar. 1, 1965). (In Russian).

The kinetic Alfven-wave current instability which is produced in plasma with finite Larmor radius when the velocities of relative motion of the electrons and the ions exceed the Alfven velocity is analyzed. Whereas in the ordinary hydrodynamic analysis of the Alfven oscillations their electric field is directed transversely to the constant magnetic field, so that there is no interaction between the wave and the particle, the situation changes if the finite Larmor radius of the ions is taken into account, for then the Alfven waves can interact with resonant particles (electrons) and can either attenuate (Landau damping) or build up (current instability). If the Alfven oscillations interact with cyclotron harmonics, the increment of the current instability with a frequency close to an integer multiple of the cyclotron frequency of the ions can be appreciably larger than the increment of the potential cyclotron oscillations. (ATD)

43424 CONDUCTIVITY OF A PLASMA IN STRONG ELECTRIC AND MAGNETIC FIELDS. Silin, V. P. (Lebedev Inst. of Physics, Moscow). Dokl. Akad. Nauk SSSR, 161: 328-31(Mar. 11, 1965). (In Russian).

The conductivity of a plasma in a strong constant and homogeneous magnetic field is determined under conditions when a strong h-f wave with circular polarization propagates along the magnetic field. The generalized Ohm's law for the plasma in a strong field is obtained with the aid of Boltzmann's equation. Spatial dispersion is neglected, and the analysis is limited to the case of frequencies low compared with the electron Langmuir frequency of the plasma and to the case of singly ionized ions. The calculations show that in strong electric and magnetic fields, the conductivity depends in nonlinear fashion on the electric field intensity. If the nonlinearity is strong, the dependence on the electric field is brought about by the fact that the field intensity determines the velocity of the colliding particles. If the nonlinearity is weak, the dependence on the electric field arises when such a field takes the colliding particles outside the collision regions. (ATD)

43425 POSSIBILITY OF THE NEGATIVE ABSORPTION OF A COLD PLASMA IN A CYLINDRICAL CAVITY. Idehara, Toshitaka (Kyoto Univ.); Takahashi, Isao; Mitani, Kenji. J. Phys. Soc. Japan, 20: 1224-9(July 1965).

The cylindrical cavity coaxial with a plasma column along the static magnetic field is analyzed. The modes examined are those which reduce to the TM_{111}, TE_{111} and TE_{011} modes in the absence of the plasma. Emphasis is placed on the case when the negative absorption are expected to occur in the vicinity of the electron cyclotron frequency. (auth)

43426 ELECTRIC DIPOLE FIELDS IN AN AXIALLY SYMMETRIC ANISOTROPIC PLASMA. Takaku, Koshun (Tohoku Univ., Japan). J. Phys. Soc. Japan, 20: 1230-9 (July 1965).

Electric dipole fields in an axially symmetric anisotropic medium are calculated by means of the cylindrical coordinates. Comparing with the spherical waves in an isotropic medium, it becomes clear that the anisotropy deforms the spherical waves into ellipsoidal waves, then it splits into two kinds of waves with different phase velocities. Far fields and near fields are also discussed. (auth)

43427 ENERGY BALANCE OF A STATIONARY D-D FUSION REACTOR WITH CONSIDERATION OF DIFFERENT ENCLOSURE TIMES OF DIFFERENT IONS. Valentini, H.-B. (Institut fuer Magnetohydrodynamik, Deutsche Akademie der Wissenschaften, Jena, East Germany). Monatsber. Deut. Akad. Wiss. Berlin, 6: 920-6(1965). (In German).

Approximations of the energy balance of a D-D reactor are calculated as a function of temperature and the product of the deuteron density and the average enclosure time of a charge carrier. In distinction to other investigations, different enclosure times of various types of ions in the plasma and different average energies with which the ions leave the plasma are considered. These variables are determined by the type of magnetic enclosure employed. For certain variable values and with negligible cyclotron radiation, a region also exists for a D-D reaction in which the $\underline{T}$-$N_D\tau$ values are such that the energy emission of the fast charged particles produced can cover the energy losses through bremsstrahlung and heating of added D. At usual temperatures and with the usual magnetic fields, this region lies at extremely high $N_D\tau$ values. Calculations on the energy exchange of a charged test particle with a fully ionized plasma are included. (BBB)

43428 COMMENTS ON "ENERGETIC ELECTRONS FROM A BEAM PLASMA OVERSTABILITY." Smullin, Louis D. (Massachusetts Inst. of Tech., Cambridge). Phys. Fluids, 8: 1412-15(July 1965).

A previous explanation (T. H. Stix, Phys. Fluids, 7: 1960 (1964)) of observations of high-energy x rays in beam-plasma interaction experiments is discussed, and objections to the explanation are presented. (C.E.S.)

43429 REPLY TO COMMENTS BY L. D. SMULLIN [ON "ENERGETIC ELECTRONS FROM A BEAM PLASMA OVERSTABILITY"]. Stix, Thomas H. (Princeton Univ., N. J.). Phys. Fluids, 8: 1415-16(July 1965).

Objections raised by Smullin (Phys. Fluids, 8: 1412 (1965)) to the explanation of observations of high-energy

x rays in beam-plasma interaction experiments (T. H. Stix, Phys. Fluids, 7: 1960(1964)) are discussed. (C.E.S.)

43430 PARTITION FUNCTIONS AND THERMODYNAMIC PROPERTIES OF NITROGEN AND OXYGEN PLASMAS. Drellishak, K. S.; Aeschliman, D. P.; Cambel, Ali Bulent (Northwestern Univ., Evanston, Ill.). Phys. Fluids, 8: 1590-1600(Sept. 1965).

The equilibrium chemical composition and thermodynamic properties of nitrogen and oxygen plasmas were calculated for six pressure (0.01, 0.1, 0.5, 1.0, 2.0, and 5.0 atm) at 100°K increments for the temperature range 2,000–35,000°K. The plasma is assumed to be a perfect gas complex consisting of seven components for nitrogen (i.e., molecules, singly ionized molecules, atoms, electrons, and the first three atomic ions) and eight components for oxygen (same as for nitrogen plus the first negative atomic ion). The internal partition functions for nitrogen molecular species were calculated by an approximate technique proposed by Mayer and Mayer using the most recent spectroscopic data available. For oxygen molecular species, the method of Stupochenko was used to determine the intermolecular potential curves, and the internal partition function was computed by direct summation over the energy states so determined. The electronic partition functions for atoms and atomic ions were computed using published data for observed electronic energy levels plus estimated energies for electronic states which are predicted but not spectroscopically observed. These electronic partition function series were terminated by application of the Debye cutoff criterion, and a corresponding lowering of the ionization potential was included. The two methods of computing the molecular internal partition function are compared and evaluated. Typical calculated data are presented in graphical and tabular form. (auth)

43431 IONIZATION RATES BEHIND SHOCK WAVES IN ARGON. Morgan, Edward J.; Morrison, Robert D. (Case Inst. of Tech., Cleveland). Phys. Fluids, 8: 1608-15(Sept. 1965).

The ionization rate behind shock waves in argon was recalculated allowing for excitation and ionization by atom–atom collisions. Good agreement is obtained between these calculations and the experimental results of others for very pure argon. For pure argon, the initial rate of ionization is controlled by the rate of excitation from the ground state by means of atom–atom collisions. The atom–atom cross sections are several percent of the corresponding electron–atom cross sections. When the degree of ionization builds up to some value greater than 10^{-4}, electron–atom collisions dominate, and then the ionization rate is controlled by the rate of energy transfer between ions and electrons by means of elastic collisions. The effect of impurities is considered, and a relatively crude theory is proposed to explain the experimental observations. It is shown that one must be careful to distinguish between ionization times and luminosity delay times. (auth)

43432 NORMAL IONIZING SHOCK WAVES. Taussig, Robert T. (Columbia Univ., New York). Phys. Fluids, 8: 1616-27(Sept. 1965).

Solutions to the steady-state jump equations are obtained for a normal ionizing shock wave propagating into a nonconducting, quiescent gas in an electromagnetic field. Comparison of these solutions to pure magnetohydrodynamic shocks and ordinary gas shocks indicates that ionizing shocks are hybrids having some properties common to both magnetohydrodynamic and gas shocks. Some completely novel effects are produced by the upstream electromagnetic field. The shock velocities are bounded for a given upstream electric field strength where the electric field is assumed parallel to the shock plane. For electric fields larger than a critical value, E_c, no steady compressive shocks exist, and for nonzero electric fields "switch-on" behavior is extended to slow shocks. Solutions analogous to detonation-deflagration waves were found, and the Chapman-Jouguet condition is applied to them. The complete boundary value problem is solved in the context of an electromagnetic annular shock tube to place the analytic results in the framework of experimentally observable phenomena. (auth)

43433 RESISTIVE INSTABILITY OF SHEARING MAGNETIC FIELDS IN AN INCOMPRESSIBLE PLASMA. Lessen, Martin; Deshpande, Narayan (Univ. of Rochester, N. Y.). Phys. Fluids, 8: 1676-80(Sept. 1965).

The stability of a shearing magnetic field in an incompressible plasma is examined, and it is found that the existence of a resistive mode of instability is questionable. (auth)

43434 WAVE PROPAGATION ACROSS A TWO-FLUID PLASMA DENSITY DISCONTINUITY. Haynes, Katherine A.; Kahn, David (Raytheon Co., Waltham, Mass.). Phys. Fluids, 8: 1681-8(Sept. 1965).

The reflection and refraction of waves across a density discontinuity in a two-fluid fully ionized plasma are investigated by means of the coupled linearized equations of hydrodynamics and Maxwell's equations. This extension from the previously considered electronic plasma to the two-fluid gas shows that there is energy coupling between the acoustic modes of propagation as well as the acoustic-electromagnetic coupling found before. The electron acoustic-transverse and transverse-electron acoustic wave coupling found in previous studies is reproduced here, the heavy ions having little effect on this energy conversion; however, the presence of electron–ion, ion–electron, ion–transverse, and transverse–ion coupling in the two-fluid plasma was also noted. Numerical results show that all these coupling mechanisms become most efficient as the wave frequency approaches the plasma frequency in the region of the transmitted wave. (auth)

43435 HYDROMAGNETICALLY STABLE PERIODIC MAGNETIC FIELD. BenDaniel, D. J. (General Electric Research Lab., Schenectady, N. Y.). Phys. Fluids, 8: 1689-93(Sept. 1965).

Results of the analysis of a class of periodic magnetic fields which have the property that the flux tube volume can decrease in the $\theta = 0$ plane and increase in the $\theta = \frac{1}{2}\pi$/plane. By symmetrizing the system with connecting regions between semistable units, closed surfaces of flux tube volume with negative gradient are obtained. Quadrupole and quadrupole–octupole stabilization is considered. Realizable current configurations are proposed for stabilizing a periodic mirror system. (auth)

43436 ELECTRICAL AND THERMAL PROPERTIES OF PLASMAS. Meador, W. E. Jr.; Staton, L. D. (Langley Research Center, Hampton, Va.). Phys. Fluids, 8: 1694-1703(Sept. 1965).

General theoretical expressions in terms of commonly used transport coefficients are derived and analyzed for the current density and heat flux within a partially ionized gas. Features of the development include the following: an examination of some of the relations between space charge and the Navier–Stokes hydrodynamic equations of change ending with the conclusion that only a quasi-neutral gas is consistent with linear flux theory; an explanation in terms of irreversible thermodynamics of the factor of three separating Ahtye and Spitzer–Härm thermal conductivities; a subsequent demonstration of the numerical equivalence between certain transport calculations based on the Boltzmann and Fokker–Planck kinetic equations; and a discussion and evaluation of the methods of Yos and Thomas. In addition, it is shown that, apart from a thermal diffusion term, expected to be small, the field-reduced thermal conductivity is that of Muckenfuss and Curtiss with a Butler–Brokaw reaction contribution tacked on. This means that the latter form, provided Boltzmann's equation is still reliable, is just as good for ionizing gases as for any other reacting mixture. (auth)

43437 TIME-DEPENDENT AMBIPOLAR DIFFUSION WAVES. Shimony, Z.; Cahn, J. H. (Univ. of Illinois, Urbana). Phys. Fluids, 8: 1704-7(Sept. 1965).

A theory for the propagation of a plasma into an ambient gas is proposed. It is an extension of the usual ambipolar diffusion which takes into account the inertia of the parti-

cles and predicts a finite velocity for the propagation of the plasma. The equation $\nabla^2 n_e = (1/u^2)(\partial^2 n_e/\partial t^2) + (1/D_a)(\partial n_e/\partial t)$ is obtained for the electron density in the expanding plasma, where $u = (D_a \nu_a)^{1/2}$, D_a is the ambipolar diffusion coefficient and ν_a is an "ambipolar collision frequency." u gives the speed of propagation of the plasma interface and is equal to the velocity $(kT_e/M_i)^{1/2}$, if the electron temperature T_e is much higher than the ion temperature. This equation is solved in one-dimensional geometry, and some characteristics of the solution are discussed. It is shown that the maximum density of the plasma propagates with speed u in the case of low pressure of the gas but with much lower speed in the case of higher pressure. (auth)

43438 MAGNETOSPHERIC FREE-BOUNDARY PROBLEM IN AXIAL SYMMETRY. Blum, Ronald (Univ. of Chicago). Phys. Fluids, 8: 1708-14(Sept. 1965).

An approximate solution for the steady-state interaction between a field-free streaming plasma and a magnetic dipole parallel to the stream is obtained. The free boundary (magnetopause) between the magnetic field region (magnetosphere) and the plasma is determined by the conditions that the plasma be field-free and that its kinetic pressure on the boundary balances the pressure of the magnetic field inside the boundary. The solution was derived by a combination of analytic and numerical (relaxation) methods, with an error of approximately 1% or less in the dimensions of the magnetosphere. (auth)

43439 DIFFUSION OF ELECTRONS IN MUTUALLY PERPENDICULAR ELECTRIC AND MAGNETIC FIELDS. Mouthaan, K. (Univ. of California, Berkeley). Phys. Fluids, 8: 1715-19(Sept. 1965).

The collective behavior of electrons in mutually perpendicular static electric and magnetic fields is considered. A known instability, first described by Buneman, of laminar electron flow in mutually perpendicular electric and magnetic fields is shown to necessitate a statistical description of the motion of the electrons. The motion of the electrons is described as diffusion; the diffusion tensor transverse to the magnetic field is obtained. Buneman's instability of laminar flow is shown to cause the conversion of E × B drift energy into energy of gyration about the magnetic field. The transverse diffusion tensor is obtained from the rate at which the conversion of energy takes place; this rate is taken to be equal to the growth rate of the instability obtained by Buneman. The transverse-diffusion coefficients are found to be proportional to the square of the static electric field and inversely proportional to the cube of the static magnetic field. It is shown how the results may be generalized to the case of diffusion of electrons across a magnetic field in ionized gases, by replacing the square of the velocity E/B by the mean-square thermal velocity of the electrons in the ionized gas. The results are in agreement with experimental results. (auth)

43440 INVESTIGATION OF A PLASMA FROM AN OCCLUDED GAS COLD PLASMA SOURCE. Steinhaus, James F.; Oleson, Norman L.; Barr, William L. (Univ. of California, Livermore). Phys. Fluids, 8: 1720-30(Sept. 1965). (UCRL-7935).

Results are given for various measurements made on a plasma from a hydrogen-loaded titanium washer mounted at a d-c magnetic mirror (~6 kgauss), the power being supplied to the source by a variable-length pulse line (15-635 μsec). Spectroscopic studies indicated the presence of H, Ti^+, Ti^{2+}, Ti^{3+}, O^+, O^{2+}, Al, Al^+, Al^{2+}, and Ta^+. Doppler shift measurements showed ion velocities from 5×10^5 to 2×10^6 cm/sec. Microwave cutoff measurements provided time history curves of electron density and indicated that the maximum density exceeded 3×10^{14} electrons per cm^3. Profile measurements using a thermistor close to the aperture of the plasma gun revealed that 10% of the particles were neutrals. Probe measurements showed that the electron temperature decreased during the pulse from 15 to 1 ev and from 3 to <1 ev for old and new source washers, respectively. (auth)

43441 COUPLING OF ION-ACOUSTIC TO NEUTRAL-ACOUSTIC WAVES AT A DIFFUSE BOUNDARY. Kahalas, Sheldon L.; Parker, Lee W. (Mt. Auburn Research Associates, Inc., Cambridge, Mass.). Phys. Fluids, 8: 1731-7(Sept. 1965).

The coupling of ion-acoustic (longitudinal plasma) waves to neutral-acoustic (sound) waves is treated at a diffuse boundary consisting of a partially ionized plasma of spatially varying composition. Collisions among the electrons, ions, and neutrals are represented by linear velocity terms. The effect of collisions is shown, for low frequencies, to give rise to coupling between an ion–electron (plasma) mode and a neutral (sound) mode. An approximate coupling coefficient is derived, based on an assumed analytic form for the ion–neutral collision frequency. (auth)

43442 DETECTION OF AN IONIZED GAS FRONT IN A MAGNETICALLY DRIVEN SHOCK TUBE. Rudderow, W. H.; Harkness, J. (Ling-Temco-Vought Research Center, Dallas). Phys. Fluids, 8: 1739-41(Sept. 1965).

A method of detecting the passage of the shock front and differentiating its passage from that of the current sheet in a magnetically driven shock tube is described. (D.C.W.)

43443 COMPLEX WENTZEL–KRAMERS–BRILLOUIN METHOD, LOCAL APPROXIMATIONS, AND LOW DENSITY UNIVERSAL INSTABILITY. Hoh, F. C. (Boeing Co., Seattle). Phys. Fluids, 8: 1741-3(Sept. 1965).

The WKB approximation and the local solutions of the equation $d^2\Psi(x)/dx^2 - q(x)\Psi(x) = 0$, where q and x are complex and $\Psi(x \to \pm\infty) \to 0$, are discussed first. It is then shown that a finite Debye length leads to instability of an ion-acoustic wave propagating in a nonuniform plasma almost perpendicularly to the external magnetic field. (D.C.W.)

43444 REMARKS ON AN EXACT SOLUTION OF A UNIVERSAL INSTABILITY. Pearlstein, L. D. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Phys. Fluids, 8: 1743-5(Sept. 1965).

An exact solution to the governing equations in the drift approximation which verifies the local or WKB treatment when the usual bounds are placed on the density gradient is outlined. It is concluded that, provided the Debye length and the ion gyro radius are small in comparison with the distance in which the density varies, the local, WKB solution and the exact solution are equivalent. (D.C.W.)

43445 DISSIPATIVE INSTABILITY IN MIRROR CONTAINMENT SYSTEMS. Greene, John M. (Princeton Univ., N. Y.); Coppi, Bruno. Phys. Fluids, 8: 1745-7 (Sept. 1965). (MATT-355).

A relatively slow instability which is caused by dissipation in a mirror-type plasma containment device that is supposedly stabilized by finite gyration radius effects is described. (D.C.W.)

43446 KELVIN-HELMHOLTZ INSTABILITY IN A FULLY IONIZED PLASMA IN A MAGNETIC FIELD. D'Angelo, Nicola (Princeton Univ., N. J.). Phys. Fluids, 8: 1748-50(Sept. 1965). (MATT-337).

The conditions for instability in a fully ionized plasma immersed in a magnetic field (B) are investigated under the assumption that the streaming velocity of the ions along the magnetic lines changes from point to point in a direction perpendicular to B. (D.C.W.)

43447 HIGH-FREQUENCY CONDUCTIVITY OF A PLASMA IN QUASI-EQUILIBRIUM. II. EFFECT OF A UNIFORM MAGNETIC FIELD. Wu, Ching-Sheng (California Inst. of Tech., Pasadena). Phys. Rev., 140: A118-29(Oct. 4, 1965).

A general expression for high-frequency conductivity is derived to include the effect of an external magnetic field. The limit of large ion mass is also discussed. For the special case that the unperturbed plasma is in thermodynamic equilibrium, the result obtained in the present paper reduces immediately to that previously discussed by Oberman and Shure. (auth)

43448 INTENSE MICROWAVE RADIATION FROM COLLECTIVE EFFECTS IN A PLASMA. Waniek, R. W.; Swanson, D. G.; Grannan, R. T. (Advanced Kinetics, Inc., Costa Mesa, Calif.). Phys. Rev. Letters, 15: 444-6 (Sept. 6, 1965).

The observation of radiative processes attributable to energetic electrons accelerated by collective effects in a plasma are reported. In the experiment, 200-kev x rays and the emission of microwave power of the order of 1 kw due at least in part to coherent radiation were detected. Any model invoked to account for these phenomena must be able to explain the partial coherence of the emission and the acceleration of electrons to 200-kev transverse energy in 10 nsec or less with only 20 to 50 kv applied longitudinal voltage. (J.F.P.)

43449 ON THE RESONANT EXCITATION OF PLASMA OSCILLATIONS WITH LASER BEAMS. Montgomery, David (Rijksuniversiteit, Utrecht). Physica, 31: 693-702(May 1965).

A recent proposal for the resonant excitation of longitudinal plasma oscillations by transverse electromagnetic waves provides an application of non-secular perturbation techniques on the cold plasma equations. The amplitudes and frequencies of the oscillations so excited are calculable in terms of the amplitudes and frequencies of the transverse radiation and the plasma parameters. Some numerical examples are given. (auth)

43450 DIFFRACTION BY A PERFECTLY CONDUCTING WEDGE IN AN ANISOTROPIC PLASMA. Faulkner, T. R. (Univ. of Liverpool). Proc. Cambridge Phil. Soc., 61: 767-76(July 1965).

The problem considered is the diffraction of an electromagnetic wave by a perfectly conducting wedge embedded in a plasma on which a uniform magnetic field is impressed. The plasma is assumed to behave as an anisotropic dielectric and the problem is reduced, by employing a contour integral representation for the solution, to solving a difference equation. Surface waves are found to be excited on the wedge and expressions are given for their amplitudes. (auth)

43451 PLASMA DENSITIES DUE TO HOLLOW ELECTRON BEAMS. Hartnagel, H. L. (Univ. of Sheffield, Eng.). Proc. Inst. Elec. Engrs. (London), 112: 1015-17 (May 1965).

In the drift region of an electron beam, ions are produced by collisions between beam electrons and residual gas molecules. The ions are trapped in the potential well of the electron space charge, which determines the ion density together with the thermal ion velocity. The ion density for electrostatically focused hollow beams were calculated for pressure ranges from 10^{-6} to 10^{-4} torr. The results show that the ion density produces a potential well which traps slow electrons on the axis of the system. The hollow-beam gun used produced a tubular electron beam with a perveance of 4.5 $\mu a/v^{3/2}$ and a velocity corresponding to 350 v. The length of the drift region was varied by a movable collector. A valve between the diffusion pump and vacuum chamber regulated the pumping speed so that the residual-gas pressure could be varied. At pressures above 3 torr, a pinhole collector detected a current density (J_s) of slow electrons, trapped by the positive-ion cloud inside the hollow beam. These electrons perform the same radial oscillatory movement as the ions. The origin of these electrons is discussed. A small fraction of J_s originates from plasma and scattered primary electrons. Also, a small proportion of scattered fast primary electrons may produce ion-electron pairs by collision with gas molecules. Collisions between ions and molecules can result in either ion-electron pairs being generated or simply in charge transfer (i.e., the molecule loses an electron which is immediately attached to the original ion). However, with the present ion energies, it is more than 1000 times more probable that the second effect occurs. Secondary emission occurs due to ion bombardment on the inner anode and the collector, which are the axial boundaries of the drift region. As the number of secondary electrons emitted per ion can be as high as 0.25, this effect will be the major contributor to J_s near the axis of the system. In addition, its density is proportional to the ion density, so that a pinhole measurement of this electron current gives some indication about the ion density. Due to the large ratio of radial axial velocities of the ions, the ion current can not pass through the pinhole and is not detected. (BBB)

43452 A COMMENT ON GOTO'S FORMULATION OF GENERAL SOLUTION FOR THE HOPF CHARACTERISTIC FUNCTIONAL. Hosokawa, Iwao (National Aerospace Lab., Tokyo). Progr. Theoret. Phys. (Kyoto), 34: 187 (July 1965).

Comments are made of the validity of Goto's general solution to the Hopf characteristic functional equation, and it is remarked that the Hopf equation need not be solved to obtain a formal general solution since the solution was given by the Hopf's identity theorem. (L.B.S.)

43453 MEASUREMENT OF LOW ELECTRON DENSITY IN PLASMAS USING LASER INTERFEROMETRY. Malamud, Herbert (Sperry Gyroscope Co., Great Neck, N. Y.). Rev. Sci. Instr., 36: 1507-8(Oct. 1965).

A system for the measurement of low electron densities is described in which two different cavity oscillation modes are used in such a manner that the plasma is caused to affect only one of them, changing its operation frequency. The frequency difference between the modes gives the desired information. (D.C.W.)

43454 WORK IN THE FIELD OF PLASMA PHYSICS. Michel, Alfred. Siemens-Z., 39: 428-43(May 1965). (In German).

The electric conductivity of a hydrogen plasma was determined between 5 and 12×10^3°K and the thermal conductivity between 7 and 10×10^3°K. Measurements of the SF_6 cascade arc voltage-current-characteristic show that under the same conditions the electrical field strength in SF_6 is smaller than in N_2. The decay of the conductance of an N_2 cascade arc can be described approximately by two time constants up to 100 μs after the interruption of the energy supply. In the case of an N_2 arc subject to blasting, the power dissipated by the forced convection rapidly approaches a limit of 85% of the arc power. Using a two-stage electrode-less plasma accelerator, it was possible to accelerate plasmoids to 5×10^7 cm/s. (auth)

43455 ON MODEL THEORY OF CYLINDRICALLY SYMMETRIC ARCS WITH RADIAL MASS FLOW. Schmitz, G.; Druxes, H.; Patt, H. J. (Technische Hochschule, Aachen). Z. Physik, 187: 271-89(1965). (In German).

Starting with the basic equations of the single-fluid model of plasma physics, the properties and the dependence upon parameters are calculated analytically for an electric arc in which a mass flow is streaming in at the wall. For that purpose, two different models were developed. Comparing the results with those of an arc without mass flow, it is found that the heat flux to the wall is strongly reduced by the contraction of the arc kernel. Therefore, it is possible to produce higher axis temperatures if the wall load is the same and the electric power is correspondingly increased. The different behavior is essentially caused by the magnitude of the radial mass flow. (auth)

43456 ANALYTICAL AND EXPERIMENTAL PERFORMANCE OF CAPACITOR POWERED COAXIAL PLASMA GUNS. Michels, C. J.; Heighway, J. E.; Johansen, A. E. (Lewis Research Center, Cleveland). New York, American Inst. of Aeronautics and Astronautics, 1965, Preprint No. 65-340, 16p., $1.00. (CONF-650711-47). ORINS.

From AIAA 2nd Annual Meeting and Technical Demonstration, San Francisco.

Experimentally derived calorimetric exhaust efficiencies are compared with efficiencies predicted from a snowplow model analysis. Four geometries are studied for a range of initial masses and voltages. Variation of kinetic efficiency with a mass loading parameter, with parasitic induc-

tance, and mass distribution is examined. For a simplified case in which drag, radiation, and ionization losses are not considered, optimum values for the first two of these parameters are nearly constant over a practical range of mass distributions. The kinetic efficiency for these optimum values theoretically increases monotonically from 27 to 93 percent as the mass distribution is varied from uniform to that of a slug. Experimentally stable operation of a gun has been limited to mass distributions for which the simplified analysis limits efficiency to about 40 percent. Experimentally measured efficiencies for properly operating guns are approximately half those predicted with the simplified analysis. The simplified model is a special case of a more complete theory that is presented, but for which detailed calculations have not yet been made. Preliminary results for one of the geometries indicate that peak efficiencies predicted are about 25 percent lower than those given by the simplified theory. (auth)

43457 PLASMA PROPERTIES IN AN INDUCTIVE PULSED PLASMA ACCELERATOR. Dailey, C. L. (TRW Systems Group, Redondo Beach, Calif.). 42p. (CONF-650813-1). ORINS.

From 6th Biennial Gas Dynamics Symposium, Evanston, Ill.

An inductive pulsed plasma accelerator, employing an edge-wound, spiral, coil was operated with sufficient preionization to produce a diamagnetic discharge in argon on the first half-cycle. A simplified model of the acceleration process is suggested on the basis of plasma properties measured along the accelerator axis at the coil midradius. The measurements indicate that the current layer is composed of an electron current front followed by a region of ion current. The latter is explained in terms of azimuthal acceleration of the ions produced by the induced electric field. About half of the axial impulse delivered to the ions comes from the axial electric field produced by polarization; the remainder arises from the Lorentz force which converts the azimuthal ion velocity to axial velocity. Thus the ion motion resembles an ExB drift which persists for one-half of a cycle only as the ion passes through the accelerator. During the acceleration period the plasma has angular momentum associated with the azimuthal ion motion. Since the axial drift of the electrons occurs in orbits which are small compared to the accelerator length, they contribute no angular momentum. The neutral plasma therefore has the angular momentum of the ions which, in the present model, is attributed to the induced electric field. A pressure dependence has been noted in that the current layer front evidently travels several times faster than the ions below about 40 microns pressure, whereas the ions stay with the current layer at higher pressures. The measurements suggest that the increased velocity at low pressure may result from a breaking up of the electron current at the front of the layer. (auth)

43458 A MATHEMATICAL PROBLEM IN THE QUASI-LINEAR THEORY OF PLASMA WAVES. Trocheris, Michel (EURATOM-CEA, Fontenay-aux-Roses, France). 46p. (CONF-650440-3). Gmelin, AED-CONF-65-095-3.

From American Mathematical Society, 622nd Meeting, New York.

The problem of plasma waves is treated in a self-consistent model which provides a closed system of equations of the distribution functions and the electric fields. Purely longitudinal plasma oscillations with no magnetic field are considered; the distribution function satisfying the Liouville equation and the field calculated from the distribution function by means of Maxwell's equations. (L.B.S.)

43459 HYPERSONIC PLASMA THERMOCOUPLE. Cotter, Theodore P. (to U. S. Atomic Energy Commission). U. S. Patent 3,206,624. Sept. 14, 1965.

A thermionic device is designed which is mounted on a vehicle capable of sufficient velocity through a gaseous medium to ionize the adjacent gas. The device consists of a hot emitting electrode and a relatively cooler collecting electrode, the collecting electrode being placed behind the emitting electrode. (AEC)

43460 METHOD AND APPARATUS FOR DYNAMIC PINCH PULSE MASER PUMPING. Colgate, Stirling A.; Trivelpiece, Alvin W. (to U. S. Atomic Energy Commission). U. S. Patent 3,209,281. Sept. 28, 1965.

A method of maser pumping is described. A high temperature plasma is heated to partially ionize and excite an ionic species to furnish line radiation which matches the pumping frequency of the maser material. Preferably, the plasma is heated and thermally excited by inducing a dynamic pinch therein. The plasma may comprise a first component of lower atomic weight and a second component of higher atomic weight which is excited to produce the desired line radiation. Principal advantages of the present dynamic pinch maser pumping method is the high-level intensity of the pumping radiation output which is up to about three times as intense as that furnished by conventional xenon flash lamp sources and the efficient transfer of energy at an optimum radiation wavelength. (AEC)

Shielding

Refer also to abstracts 42682 and 42716.

43461 (NP-15385) VYKHOD I UGLOVOE RASPREDELENIE VTORICHNYKH NUKLONOV IZ PLOSKIKH ZASHCHIT POD DEISTVIEM PROTONOV S ENERGIEI 660 Mev. No. 8. (Yield and Angular Distribution of Secondary Nucleons From Flat Shielding Under the Action of 660-Mev Protons. No. 8). Kon'shin, V. A.; Matusevich, E. S.; Regushevskii, V. I. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1965. 21p. Dep. mn.

Angular distributions and yields of secondary nucleons behind plane shielding from C, Al, Ni, and Pb were measured. The number of nucleons was obtained in three energy groups. The 660-Mev proton beam was incident perpendicular to the shield. Results are compared with published data. (tr-auth)

43462 (ORNL-TM-1205) A DETERMINATION OF INTERMEDIATE-ENERGY NEUTRON ALBEDO DATA FOR CONCRETE USING MONTE CARLO (thesis). Coleman, W. A. (Oak Ridge National Lab., Tenn.). Sept. 1965. Contract W-7405-eng-26. 71p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Submitted to Univ. of Tennessee, Knoxville.

The differential energy-angle albedo data were calculated for a semi-infinite steel reinforced concrete medium using a series of incident angle and energy conditions. The energy range from 0.5 ev to 200 kev was divided into ten groups ΔE_δ^i equally spaced in lethargy. The incident angles were 0, 45, 60, 75, and 85°. A general purpose Monte Carlo neutron transport code, 05R was used to obtain a collision distribution for each incident energy band ΔE_δ^i and angle θ_δ^i. The distribution of reflected neutrons in energy and angle was determined by computing, at each collision, the probability of escape along each of 54 directions (defined by angles θ_δ and ϕ_m). In addition to the differential energy angle albedo the following studies were made for intermediate energies: the radial dispersion of reflected neutrons from the point of incidence; the distribution in depth and energy of intermediate energy captures; the distribution in polar angle θ_δ and depth of those neutrons which were degraded below 0.5 ev. before escaping. The reflected singly scattered spectra calculated analytically agreed (within statistics) with the Monte Carlo estimate of the singly scattered spectra. A comparison study showed the Monte Carlo results to be in good agreement with those obtained by using the S_n method. (auth)

43463 (TIM-941) MONTE CARLO CODES, FMC-N AND FMC-G. Kinney, E. E. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineer-

ing Lab.). July 22, 1965. Contract AT(30-1)-2789. 124p. Dep. mn; CFSTI $4.00 cy, $0.75 mn.

The flexible Monte Carlo codes, FMC–N and FMC–G, were converted from 7090 machine language to Fortran for the Control Data 1604-B computer. The program was originally written for studies of neutron transport or gamma transport problems in a source-shield configuration. The modifications and additions that were made are described. Since the program is written in Fortran it can be converted to any machine with at least 6 tape units. The tapes needed are discussed. (M.O.W.)

43464 A COMPARISON OF SHIELDING CALCULATIONS WITH ABSOLUTE MEASUREMENTS IN MASSIVE SHIELDS. Aalto, Erkki J. (Aktiebolaget Atomenergi, Stockholm). Nucl. Appl., 1: 359-74(Aug. 1965).

Extensive neutron and gamma attenuation measurements were performed in magnetite and ordinary concrete up to a depth of 2m to collect reference data for a study of the accuracy attainable by shield calculation methods. Experimental facilities and the configurations studied are described accurately enough to enable the reader to test his own methods against these measurements. Great weight was laid on absolute accuracy and a thorough error analysis. The fluxes measured were compared to those calculated by an earlier version of the British 18-group removal method (RASH B_3), by an improved removal method (NRN) developed at AB Atomenergi, and by numerical integration of Boltzmann equation (NIOBE). Calculations with the new methods give fluxes that are generally within a factor of 2 of the true values. Any greater accuracy seemed to be difficult to obtain in practice in spite of possible improvements in the mathematical solution of the transport problem. The greatest errors originated in going from the true geometry to that used for calculation, in the uncertainty of material properties in the case of concrete, and in approximations and inaccuracies of radiation sources. (auth)

43465 DIFFERENTIAL DOSE-RATE MEASUREMENTS OF BACKSCATTERED GAMMA RAYS FROM CONCRETE, ALUMINUM AND STEEL. Haggmark, L. G.; Jones, T. H.; Scofield, N. E.; Gurney, W. J. Nucl. Sci. Eng., 23: 138-49(Oct. 1965).

The angular distribution of backscattered dose-rate ratio was measured for "semi-infinite" concrete, aluminum and steel slabs irradiated by plane-parallel beams of ^{60}Co and ^{137}Cs gamma photons. The photons were incident on the slabs at angles, measured from the normal to the slab, of arccos 1.00, 0.75, and 0.50. For the necessary sensitivity, the backscattered dose rate was measured by a digital dosimetry system using a plastic scintillator as the detector. An empirical formula for differential dose-rate ratio was derived from the experimental data. Comparisons are made with two other experiments and a semi-empirical formula fitted to a Monte Carlo calculation. The experiments generally agree to within 20%. The values based upon the Monte Carlo calculation are generally 20% to 35% lower than the experimental values. (auth)

Solid State Physics

See also CHEMISTRY — Inorganic and Physical Chemistry
METALS, CERAMICS, AND OTHER MATERIALS — Properties and Structure

43466 (AEET-203) CDC-3600 FORTRAN CRYSTALLOGRAPHIC PROGRAMS FOR NEUTRON DIFFRACTION. PART I. NP-SFLS 1. Srikanta, S. (Atomic Energy Establishment, Trombay (India)). 1965. 34p. Dep. mn.

A description is given of the CDC-3600 computer program for the least squares refinement of crystal structure parameters based on neutron diffraction measurements. The complete program, written in Fortran language, is for refining two dimensional data with isotropic temperature factors. This program can be easily modified for refining three dimensional data and with anisotropic temperature factors. (auth)

43467 (AERE-R-4934) TABLES OF Sin x/x TO SIX DECIMAL PLACES. Martin, D. G. (Atomic Energy Research Establishment, Harwell (England)). May 1965. 118p.

Tables of the function Sin x/x to six decimal places are given for values of x between (a) 0 and 50 radians in intervals of a thousandth of a radian, and (b) 50 and 100 radians in intervals of a hundredth of a radian. In both tables first differences are also given. (auth)

43468 (IAE–863) MODEL' IZINGA PRI VZAIMODEISTVII S NEBLIZHAISHIMI SOSEDYAMI. (The Ising Model in the Case of Interaction with Non-proximate Neighbors). Vaks, V. G.; Larkin, A. I.; Ovchinnikov, Yu. N. (Institut Atomnoi Energii, Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1965. 20p. Dep. mn.

A two-dimensional Ising lattice is considered, in which, besides the usual interaction, between the junctions having identical parity of rows and columns, there is an interaction along the diagonals. The free energy and the spontaneous magnetization intensity are found as functions of temperature. The form of the correlation function is obtained at large distances from the point of phase transition and near to it. (tr-auth)

43469 (IAE–864) O FAZOVYKH PEREKHODAKH VTOROGO RODA. (Phase Transitions of the Second Type). Vaks, V. G.; Larkin, A. I. (Institut Atomnoi Energi Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1965. 24p. Dep. mn.

It is shown that, for a certain relation of constants, the singularities of the thermodynamic values during type-II phase transitions with change of crystal symmetry and in binary alloys have the same form as in the Ising model, for which a series of results is known from machine calculations. Reasons are presented that additional terms do not change the result. A phase transition in a Bose gas turns out to be equivalent to a transition in a lattice of plane dipoles. (tr-auth)

43470 (IS-T-21) MAGNETOSTRICTION OF Dy, Er, AND Tb SINGLE CRYSTALS (thesis). Rhyne, James Jennings (Ames Lab., Iowa State Univ. of Science and Tech.). July 1965. Contract W-7405-eng-82. 179p. Dep. mn; CFSTI $5.00 cy, $1.00 mn.

The magnetostriction of Dy, Er, and Tb single crystals was measured from 300 to 10°K in applied magnetic fields up to 30 kOe. The temperature dependence of the magnetostriction constants appropriate to Tb and Dy was determined under the assumption that the magnetic moment is constrained to the basal plane by the magnetic anisotropy energy. The eleven magnetostriction constants appearing in the general fourth order theory are reduced to four constants in this case. The second and fourth order orthorhombic distortion constants were evaluated by strain measurements as a function of applied field direction in the basal plane. The remaining two constants describe isotropic dilatations of the basal plane and c axis. These were determined from isofield measurements of the a-, b-, and c-axis strain and subtraction of the thermal strain extrapolated from the paramagnetic region. In these measurements the saturating field was applied along the easy magnetic axis. The theoretical dependence of the anisotropic distortion constants on the magnetic moment was evaluated for Tb and Dy. The linear strains along the a, b, and c axes were obtained as a function of field applied along the easy axis. The anomalous results obtained in the helical antiferromagnetic temperature ranges are discussed. From these results the forced magnetostriction along the three axes was determined. Values of the six fold basal plane anisotropy constants of Dy and Tb were calculated from the magnetostriction data as a function of applied field angle. The measurement of magnetostriction

of Er was complicated by the extremely high axial magnetic anisotropy which constrains the magnetic moment to the surface of a cone about the c axis. Only a semiquantitative determination of the anisotropic constant was possible. The field induced changes in the magnetic states of Er were studied, and a qualitative model explaining the effects was postulated. The temperature dependence of the strains in zero applied field and in a 30 kOe field applied in the basal plane and along the c axis was measured. (auth)

43471 (NAA-SR-11150) CALCULATIONS OF THE MADELUNG CONSTANT AND INVERSE TWELFTH POWER REPULSION FACTORS FOR THE WURTZITE CRYSTAL STRUCTURE. Gehman, William G. (Atomics International, Canoga Park, Calif.). July 25, 1965. Contract AT-11-1-GEN-8. 84p. Dep. mn; CFSTI, $3.00 cy, $0.75 mn.

The Madelung constant and the inverse twelfth power repulsion factor were calculated for the wurtzite structure for wide ranges of the crystal parameters c_0/a_0 and u (the u-parameter being a measure of the MX bond distance parallel to c_0). The Madelung constant for the known compounds AlN, BeO, and AgI, plus that for the hypothetical "ideal" wurtzite structure, are respectively 2.699, 2.686, 2.678, and 2.680. Minima are found for both the Madelung constant and the inverse twelfth power repulsion factors when they are plotted versus u for a fixed value of c_0/a_0. These extrema imply the existence of broad maxima in the electrostatic energy (E_e) and relatively steep minima in the repulsion energy (E_r) in a three-dimensional (c_0/a_0)-u-(potential energy) space. The maxima in E_e and the minima in E_r determine an "energy valley" in which the wurtzite compounds are constrained to lie. (auth)

43472 DEGENERATE PINCH IN InSb. Akramov, G. (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 161: 554-5(Mar. 21, 1965). (In Russian).

A formula is derived for the radius of a plasma pinch in an electron-hole plasma in InSb, making use of highly simplifying assumptions (the free electron-hole gas model). It is shown on the basis of Maxwell's equations that the radius of the pinch is proportional to the current raised to the −0.25 power. The results can be reconciled with the experiments of Ancker-Johnson and Drummond if it is assumed that the electron drift velocity is 10 times larger than the speed of sound (approximately $2 - 5 \times 10^5$ cm/sec). The proportionality constant between the radius and the current raised to the −0.25 power is then close to unity. (ATD)

43473 ELECTRON AND LATTICE TRANSPORT PHENOMENA IN AN ANTIMONY CRYSTAL AT LIQUID-^{4}He TEMPERATURES. Long, J. R.; Grenier, C. G.; Reynolds, J. M. (Louisiana State Univ., Baton Rouge). Phys. Rev., 140: A187-201(Oct. 4, 1965). (TID-22054).

In a very pure single crystal of antimony, a complete set of kinetic transport coefficients of the galvanomagnetic and thermomagnetic effects was determined at each of the temperatures 1.6, 2.1, 3.0, and 4.0°K in fields up to 18 kG. Standard measuring techniques were employed. An electron-phonon normal process was found to dominate the scattering for both electronic and lattice conduction. The usual theories assuming a time of relaxation were applied to the gross coefficients, while the oscillations found at the higher fields were analyzed in terms of the several existing theories which take account of Landau quantization. Both the lattice thermal and ideal electrical conductivities appeared to be anomalous in magnitude and temperature dependence, but their ratio was very satisfactorily fitted to the relation expected for an N process. A standard two-band model assuming a time of relaxation gave remarkably good agreement with data for the field dependence of the gross effects. The magnitude and large temperature dependence of the Nernst-Ettinghausen coefficient were satisfactorily explained by a simple theory of phonon drag. Since the lattice conductivity was limited by electron scattering, the oscillations in the lattice thermal resistivity were quantitatively shown to be a result of an oscillation in the density of scattering centers, as a consequence of Landau quantization. (auth)

43474 RELAXATION OF EXCITON STATES IN ALKALI-HALIDE CRYSTALS. Wood, R. F. (Oak Ridge National Lab., Tenn.). Phys. Rev. Letters, 15: 449-52 (Sept. 6, 1965). (ORNL-P-1335).

Results of calculations are reported on exciton states in NaCl and KCl which support the validity of the suggestion that lattice relaxation may play an important role in the interpretation of absorption, emission, and photoconductivity experiments in pure ionic crystals, especially the alkali halides. The calculations are thought to show that it is possible for photoconductivity to occur without necessarily implying direct transitions to conduction band states. They also indicate that, whereas the energy of the many-electron excited state responsible for the second absorption peak may lie in the band of energies of the many-electron conduction states, the single-particle function describing the electron principally involved in the transition is localized. (J.F.P.)

43475 STARK EFFECT OF 4f STATES AND LINEAR CRYSTAL FIELD IN BaClF : Sm^{2+}. Kiss, Z. J.; Weakliem, H. A. (RCA Labs., Princeton, N. J.). Phys. Rev. Letters, 15: 457-60(Sept. 6, 1965).

The first observation of an external Stark effect on 4f states is reported. The system studied was BaClF : Sm^{2+}, and the electric effect was found to be of the same order of magnitude for the 4f states as that previously found for the 3d states. In order to explain the Stark effect and the intensities of some of the transitions, an odd-parity potential term which varies linearly with electron distance is invoked. By using such a term a relation was obtained between the Stark splitting and the oscillator strength for some of the transitions. The study was performed by observing the change in the fluorescent spectrum of the $^5D_J \rightarrow {}^7F_J$ transitions of Sm^{2+} as the external field was varied. (J.F.P.)

43476 CORRELATION OF SELF DIFFUSION DATA IN METALS AS A FUNCTION OF THERMAL EXPANSION COEFFICIENT. Askill, J. (Oak Ridge National Lab., Tenn.). Phys. Status Solidi, 11: K49-50(Sept. 1, 1965).

The self-diffusion activation energies for various metals were plotted as a function of the linear thermal coefficient of expansion. The results of an analysis of Arrhenius plots for beta titanium and zirconium in terms of two processes operating at low and high temperatures, respectively, were found to agree reasonably well with the curve. Low-temperature values of the activation energy for beta titanium, beta zirconium, beta hafnium, and gamma uranium fall well below the curve. An approximate equation is given for the curve. (D.C.W.)

43477 EFFECT OF THERMAL DIFFUSE SCATTERING ON PROPAGATION OF HIGH ENERGY ELECTRONS THROUGH CRYSTALS. Hall, C. R.; Hirsch, P. B. (Cambridge Univ., Eng.). Proc. Roy. Soc. (London), Ser. A, 286: 158-77(June 22, 1965).

A simple theory is developed for calculating the contribution from thermal diffuse scattering to the absorption of high energy electrons passing through crystals. The Einstein model for a vibrating crystal is used; and the incident wave is assumed to be a Bloch wave, the thermally diffuse scattered wave to be a plane wave. It is shown that thermal diffuse scattering makes an important contribution to absorption, particularly for elements of high atomic number. The theory also predicts a strong anomalous absorption effect for low order reflections. The mean and anomalous absorption coefficients are strongly temperature dependent. An improvement of several times the penetration at room temperature is predicted for the penetration at low temperatures, for elements of high atomic number and low Debye temperature θ. In practice the improvement realized is probably limited by another, less temperature-dependent, absorption process due to electronic excitations. Careful experimental measurements

of absorption coefficients at low temperatures are needed. (auth)

43478 QUANTUM STATES OF THE F_2^+ CENTRAL ELECTRON. Wang, Shao-fu (Tunghai Univ., Taiwan, China). Progr. Theoret. Phys. (Kyoto), 33: 1001-9(June 1965).

The quantum states of the F_2^+ center electron are calculated using the method proposed in a previous paper, which takes into account the effect of the phonon field. The possibility that the L band arises from the F_2^+ center is discussed. (auth)

43479 METHOD OF INVARIANTS IN A HYPERFINE INTERACTION. Zheru, I. I. (Inst. of Semiconductors, Kiev). Ukr. Fiz. Zh., 10: 726-33(July 1965). (In Ukrainian).

The group theoretic method for obtaining invariant expressions is applied for constructing a spin-hamiltonian of hyperfine interaction of a local paramagnetic center. With this approach to the F-centers in a KCl type crystal, additional components appear in the spin-hamiltonian, consideration of which in the zero approximation of perturbation theory leads to disturbance of equidistance of the quadruple lines of the ENDOR spectrum. (auth)

43480 LATTICE DYNAMICS OF TRANSITION METALS. Woods, A. D. B. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp 87-94 of STI/PUB/92(Vol.I).

The frequency versus wave-vector $\nu(\vec{q})$ dispersion relations for the normal modes of vibration of several body-centered cubic transition metal crystals have been measured at room temperature. The dispersion curves for niobium displayed some very unusual features, and the results could only be fitted by means of a Born-von Kármán model if interactions out to very distant neighbors (beyond eighth) were included. Measurements of the dispersion curves of molybdenum tungsten showed that although these metals, which are in column VI of the periodic table, had dispersion relations that were similar to each other, these dispersion relations were very different from those of the column V metals, niobium and tantalum. The gross features of the $\nu(\vec{q})$ for molybdenum and tungsten were very nearly describable by a third neighbor axially-symmetric Born-von Kármán force model, although several important features were not reproduced by this model. One of these features is a striking anomaly in the $[\xi\xi\xi]$ longitudinal (L) branch for molybdenum where the frequency changes from $\nu = 6.3 \times 10^{12}$ c/s at $\xi = 0.92$ to $\nu = 5.5 \times 10^{12}$ c/s at $\xi = 1.0$. If this and other observed features are Kohn anomalies, their positions are consistent with the proposed dimensions of the Fermi surface of the column V metals. Thus it is suggested that the striking differences between the dispersion relation for niobium and that for molybdenum (metals which are believed to have quite similar band structures) reflect differences in the Fermi energies and hence the Fermi surfaces for these materials. (auth)

43481 THE NATURE OF THE PHONON SPECTRUM AND THE ANALYSIS OF LATTICE THERMAL CONDUCTIVITY. Joshi, S. K.; Sharma, K. C. (Allahabad Univ., India). pp 285-96 of STI/PUB/92(Vol.I).

An analysis of lattice thermal conductivity is presented, wherein a realistic phonon spectrum is utilized that is more realistic than the usual Debye-like phonon spectrum consisting of one average acoustic branch. An anisotropic continuum dispersive model is used in a calculation of the temperature dependence of the lattice thermal conductivity of germanium. Six- and three-term integration procedures are used in evaluating integrals over lattice frequencies. Suitable prevalent expressions for relaxation times for boundary and impurity scatterings and three-phonon normal and Umklapp processes are used. The experimental data are reproduced for germanium from 2 to 1000°K by adjusting the four constants occurring in the integrals. On the face of reliable neutron spectroscopic evidence, germanium is known to have very disperse transverse branches. For these, an anisotropic continuum dispersive model also yields a poor representation. The very elaborate shell model for the lattice dynamics of germanium put forth by Cochran is therefore used. With a proper adjustment of the parameters entering in our formulation for the calculation of lattice thermal conductivity, we find a fit with the experimental data. It is concluded that the nature of the phonon spectrum does not greatly influence the analysis of lattice thermal conductivity data according to current approaches, and the niceties of the phonon spectrum are lost in the adjustment of the various parameters involved. It is felt that instead of putting too much labor in evaluating the tedious integrals for more realistic lattice dynamical models, it is better to investigate the validity of various relaxation time assumptions that have gone into these integrals. (auth)

43482 MICROSCOPIC THEORY OF TRANSITIONS ACCOMPANIED BY MODIFICATION OF CRYSTALLINE STRUCTURE. Boccara, N.; Sarma, G. (Centre d'Etudes Nucleaires, Saclay, France). pp 313-23 of STI/PUB/92 (Vol.I). (In French).

A self-consistent microscopic theory is proposed for certain transitions where the determining factor is the influence of thermal agitation. The method is particularly applicable to displacive ferroelectric substances. A discussion of the equations derived leads to a number of general conclusions near the point of transition. The properties found in this manner agree with the experimental results. (auth)

43483 STRAIN DEPENDENCE OF THE FREQUENCIES AND THERMAL EXPANSION OF THE HEXAGONAL CLOSE-PACKED LATTICE. Srinivasan, R.; Ramji Rao, R. (Indian Inst. of Tech., Madras). pp 325-42 of STI/PUB/92(Vol.I).

The anisotropic thermal expansion of some hexagonal metals are measured. To work out the theory of anisotropic thermal expansion of hexagonal close-packed (hcp) lattices, it is necessary to investigate the strain dependence of the frequencies of the hcp lattice. The hcp lattice with nearest-neighbor central interaction is considered. The strains employed are a longitudinal expansion along the z-axis, and a uniform areal expansion in the basal plane. There are the relevant strains in the theory of thermal expansion and they have the advantage that they do not involve interlattice displacements. The Grüneisen parameters are worked out for wave-vectors lying along certain symmetry directions. These parameters for the acoustic branches are found to be strongly direction-dependent and to exhibit a wide variation. One of the transverse acoustic branches in the basal plane has a negative value of γ'', whatever the values of m and n are. The dependence of the moments on the strains is worked out. The high and low temperature limits of the equivalent Grüneisen parameters $\overline{\gamma}'$ and $\overline{\gamma}''$ have been worked out for three pairs of values of m and n. It is found that $\overline{\gamma}' = \overline{\gamma}''$ and the high temperature limit $\overline{\gamma}'_\infty$ is greater than the low temperature limit $\overline{\gamma}'_0$ by about 0.3. The magnitude of this difference appears to be independent of the values of m and n. Taking farther-neighbor interaction into account, one may expect to reduce this difference. These theoretical results are compared with the experimental results in magnesium. (auth)

43484 DYNAMICS OF MAGNETIC SYSTEMS INVESTIGATED BY MOESSBAUER AND NEUTRON SCATTERING EXPERIMENTS. Marshall, W. (Atomic Energy Research Establishment, Harwell, Berks, Eng.). pp 399-412 of STI/PUB/92(Vol.I).

A discussion is given of Lamb-Mössbauer and neutron scattering experiments which can be used to investigate magnetic systems. It is shown that only in very special circumstances can the Mössbauer effect be used to examine directly the fluctuations of the magnetic spins with time. Therefore the Mössbauer effect is usually used to measure time-average quantities. It follows that Mössbauer experiments are closely related, in principle, to strictly elastic neutron scattering experiments. Both techniques and also the nuclear magnetic resonance technique are useful in studies of ferromagnetic alloys. Recent studies of this kind are reviewed and the difficulties of interpreting the experiments are described. (auth)

43485 DIFFUSE SCATTERING FROM ALLOYS AND DISORDERED SYSTEMS: EXPERIMENTAL TECHNIQUES AND POTENTIALITIES. Low, G. G. (Atomic Energy Research Establishment, Harwell, Berks, Eng.). pp 413-31 of STI/PUB/92(Vol.I).

The types of information that may be obtained by studying the elastic diffuse scattering of neutrons are reviewed. Attention is concentrated on systems where there is a random arrangement of defects, each of which may be assumed to be unaffected by the presence of its fellows, either because of dilution or because of an intrinsic lack of dependence on environment. In these circumstances the pattern of scattered intensity is proportional to the square of the modulus of a Fourier transform over the disturbance in scattering amplitude associated with a defect. Thus, information on the spatial distribution of defect scattering amplitude can be obtained by carrying out the relevant neutron scattering measurements and performing a Fourier inversion. In practice, because of the large number of processes contributing to the diffuse scattering background, measurements have so far been possible only in a limited number of fields. In particular, considerable progress has been made in connection with magnetic defects in ferromagnets, where the magnetic cross section may be controlled by changing the direction of magnetization relative to the neutron scattering vector. In this way the scattering of interest can be isolated from the non-magnetic effects as a difference between two intensity measurements. A process contributing to the diffuse scattering background which is partly magnetic in character and therefore not eliminated by the above technique is multiple Bragg scattering in a magnetic polycrystal. This may be avoided by the use of a single-crystal specimen or by employing long wavelength neutrons such that no Bragg processes are possible. An instrument based on the latter principle has been developed at Harwell and used in connection with a wide range of measurements on dilute ferromagnetic alloys. These observations are discussed along with a number of other likely future developments in the field. Included among the latter are measurements of the diffuse magnetic scattering from paramagnetic salts. Observations of such scattering are of great interest since they contain direct information on the amount of spin transferred, as a result of covalency, from a magnetic ion on to the ligands which surround it. (auth)

43486 NEUTRON SCATTERING BY PARAMAGNETICS. Satya Murthy, N. S.; Venkataraman, G.; Usha Deniz, K.; Dasannacharya, B. A.; Iyengar, P. K. (Atomic Energy Establishment, Trombay, India). pp 433-42 of STI/PUB/92(Vol.I).

The scattering of cold neutrons by paramagnetic MnO has been studied using a rotating crystal spectrometer. Energy distributions have been obtained at several scattering angles and temperatures. Some measurements have also been made at thermal energies. The cold neutron data indicate that there is considerable inelasticity in the scattering, the details of which are determined by the nature of the time-dependent spin-correlation functions. First and second neighbor exchange integrals have been evaluated from the second moments of the energy distribution at large scattering angles. A damped magnon model has been suggested to explain the details of the observed energy spectra. Results on $KMnF_3$ are also presented. (auth)

43487 LATTICE DYNAMICS. Proceedings of the International Conference held at Copenhagen, Denmark, August 5-9, 1963. Wallis, R. F. (ed.). The Journal of Physics and Chemistry of Solids, Supplement 1, 1965. New York, Pergamon Press, 1965. 745p. $28.50. (CONF-204).

One hundred and two papers are included; separate abstracts have been prepared for 8. Three have been previously abstracted for NSA; see abstracts 17:39713, 18:715 and 34262. In addition, three short introductory discussions are included. These have not been abstracted nor included in the enumeration of the theoretical papers. The 102 papers are divided into 7 main divisions: phonon curves, 32 papers, 4 of which are abstracted here or have been previously abstracted; anharmonic effects, 11 papers, 2 of which are abstracted; optical and dielectric effects, 18 papers, none of which have been abstracted; defects and lattice vibrations, 20 papers, 3 of which are abstracted here or previously; elasticity, 8 papers, none of which have been abstracted; recent developments in lattice dynamics, 11 papers, 2 of which are abstracted here; and a summary, 2 papers, not abstracted. (B.L.M.)

For abstracts of individual papers see: 43488—43495.

43488 LATTICE VIBRATIONS OF $LaCl_3$. Caspers, H. H.; Murphy, J.; Buchanan, R. A. (Naval Ordnance Lab., Corona, Calif.). pp 109-17 of Lattice Dynamics. New York, Pergamon Press, 1965.

A model based on central forces and involving only four force parameters were used to calculate the normal mode frequencies of $LaCl_3$. From an analysis of the $C_{3h}^1(P6_3/m)$ space group, three infrared active ($1A_{1u}$ and $2E_{1u}$), six Raman active ($2A_{1g}$, $1E_{1g}$ and $3E_{2g}$) and five non-active ($2B_g$, $2B_u$, and $1E_{2u}$) vibrational modes were determined. Three force parameters were determined by using the infrared active fundamentals that were observed at 138, 165 and 210 cm^{-1}. The frequencies of the other modes were expressed as functions of the fourth force parameter. For one value of this parameter, agreement with the observed Raman lines was obtained with an average deviation of 6.6 cm^{-1}. (auth)

43489 APPLICABILITY OF THE SHELL MODEL TO THE LATTICE VIBRATIONS OF LiH. Brodsky, M. H.; Burstein, E. (Univ. of Pennsylvania, Philadelphia). pp 175-7 of Lattice Dynamics. New York, Pergamon Press, 1965.

The "shell model" was applied to LiH and LiD where the shell concept might not be strictly valid because of the large orbits of the hydride ion valence electron and because the second neighbor interaction associated with the overlap of the two hydride ions may be appreciable. Using the model proposed by Dick and Overhauser (Phys. Rev. 112: 90(1959)), a value for the dynamic effective charge $e^* = 0.3e$ was obtained as compared with a value of 0.52e obtained by infrared and dielectric constant data. (auth)

43490 DEVIATIONS OF THE SPECIFIC HEATS OF THE ALKALI METALS FROM HARMONIC BEHAVIOUR, A POSSIBLE DEPENDENCE ON ISOTOPIC COMPOSITION OF THE ANHARMONIC CONTRIBUTION TO SPECIFIC HEAT. Martin, Douglas L. (National Research Council, Ottawa). pp 255-60 of Lattice Dynamics. New York, Pergamon Press, 1965.

An analysis of the "high temperature" specific heats of all the alkali metals shows that positive departures from harmonic lattice theory predictions occur at temperatures in the range $\theta/3$ to θ, suggesting the onset of appreciable anharmonic contributions to the specific heat in this temperature range. A further positive anomaly starting at temperatures of about 50°K below the melting point (except possibly in lithium) is believed to correspond to the thermal generation of lattice vacancies. At low temperatures the specific heats of alloys of the two isotopes of lithium are intermediate between the specific heats of the separated isotopes. However, as the temperature is increased the specific heats of the alloys increase more rapidly than do the specific heats of the separated isotopes. As a result by 300°K (where the lattice constants of the alloys and pure isotopes are probably all the same) the specific heats of alloys containing more than about 50 per cent ^7Li exceed the specific heat of pure ^7Li (which is itself greater than the specific heat of pure ^6Li). These results suggest that the anharmonic contribution to the specific heat may depend on isotopic composition. However, the observed effect is rather small (less than 1 per cent of the total specific heat), and an independent set of measurements is desirable to confirm its existence and magnitude. (auth)

43491 INELASTIC SCATTERING OF NEUTRONS BY ANHARMONIC CRYSTALS. Ambegaokar, Vinay (Cornell

Univ., Ithaca, N. Y.); Conway, John M.; Baym, Gordon. pp 261-70 of Lattice Dynamics. New York, Pergamon Press, 1965.

The widths of the one-phonon resonances in the inelastic scattering of neutrons by crystals have been observed. A theoretical framework is provided within which to determine the phonon frequencies and lifetimes from these experimental observations. When a crystal has anharmonicities, interference effects can occur between processes in which the neutron creates only one phonon and processes in which it creates several phonons; these coherences are due to the fact that when a phonon can decay into several phonons, the final state in which the neutron has created one phonon is not orthogonal to final states in which the neutron has created several phonons. It is shown that the Placzek sum rule is still a valid guide in subtracting the multiphonon background from the experimental cross section. The remaining cross section is the sum of the one-phonon cross section and the "one-phonon, several-phonon" interference terms. The one-phonon cross section has a resonance at the phonon frequency with a width proportional to the inverse of the phonon lifetime. In agreement with experimental observations, the interference terms have the effect of shifting the center of this resonance from the one-phonon frequency and also changing the shape from an expected Lorentzian form. A very crude estimate of the effect is made that indicates that under favorable conditions in lead interference effects may lead to an asymmetry in the line shape of the order of a few per cent. Apparently, the anharmonicities in a crystal place an upper limit on the accuracy with which one can directly determine the phonon frequencies and lifetimes from the one-phonon resonances in neutron scattering data. (auth)

43492 EFFECT OF ISOTOPIC COMPOSITION ON LATTICE-VIBRATION ABSORPTION OF INFRARED RADIATION IN IONIC CRYSTALS. Montgomery, D. J. (Michigan State Univ., East Lansing); Hardy, J. R. pp 491-5 of Lattice Dynamics. New York, Pergamon Press, 1965.

The infrared absorption spectrum of thin evaporated films of $Li^{19}F$ made with varying proportions of ^6Li and ^7Li, and of ^6LiH made with varying proportions of ^1H and ^2H was observed. The parameters of the principal absorption lines were studied as functions of isotopic composition, film thickness, and temperature. As ^6Li is replaced by ^7Li in $Li^{19}F$, the dispersion frequency ω_0 shifts from its value 324 cm^{-1} for $^6Li^{19}F$ to its value 307 cm^{-1} for $^7Li^{19}F$, more or less uniformly with respect to average reduced mass. But as ^1H is replaced by ^2H in ^6LiH, ω_0 drops sharply from its value 588 cm^{-1} for $^6Li^1H$ to nearly its value 448 cm^{-1} for $^6Li^2H$ at a concentration of only a few percent ^2H. Theoretical work indicates that the drastic isotopic shift results from the presence of $^2H^-$ ions which produce a local mode in the gap between optical and acoustic branches of the spectrum of ^6LiH. (auth)

43493 ON THE ELASTIC AND INELASTIC MOESSBAUER EFFECT FOR IMPURITY ATOMS IN A CRYSTAL AND THE EFFECT OF SUCH ATOMS ON NEUTRON SCATTERING. Waller, I. pp 517-21 of Lattice Dynamics. New York, Pergamon Press, 1965.

Using semiclassical arguments, a derivation is first given of the formulas for the scattering of neutrons by a general system of nuclei in thermal equilibrium and for the emission of γ rays. Some considerations are given concerning the application of these formulas to crystals containing impurities. (auth)

43494 THE MOESSBAUER EFFECT AND ITS RELATION TO LATTICE DYNAMICS IN SIMPLE LATTICES. Visscher, William M. (Los Alamos Scientific Lab., N. Mex.). pp 643-52 of Lattice Dynamics. New York, Pergamon Press, 1965.

A brief discussion is given of the possible applications of the Mössbauer effect to the study of lattice dynamics. Particular emphasis is given to those aspects which are hard to measure by any other technique, namely, the properties of isolated impurities. The effects of localized modes, of anharmonicities in the impurity coupling, and of proximity to a free surface are mentioned. (auth)

43495 LATTICE DYNAMICS AND SPIN-LATTICE INTERACTION IN SOLID HYDROGEN. Van Kranendonk, J. (Univ. of Toronto). pp 689-92 of Lattice Dynamics. New York, Pergamon Press, 1965.

Various aspects of the lattice dynamics of solid hydrogen were studied in connection with the interpretation of the infrared and Raman spectra of this solid. A survey is given of the theoretical work carried out on the lattice vibrational spectrum, the stability of the solid, the intensity of the phonon branches in the infrared spectrum, and the effects arising from the coupling between the lattice vibrations and the rotational motion of the molecules. (auth)

43496 THE MOESSBAUER EFFECT IN IRON UNDER VERY HIGH PRESSURE (thesis). Pipkorn, David Nieman. Urbana, Ill., Univ. of Illinois, 1964. 60p.

The Mössbauer spectrum of ^{57}Fe in iron metal was measured at pressures up to 240 kilobars at room temperature. Below 133 kilobars the spectrum consists of the normal six lines characteristic of ferromagnetic, body-centered cubic iron. The internal magnetic field at the nucleus H decreases linearly with pressure; $\Delta H/H_0 = -1.6 \times 10^{-4}$ $kilobar^{-1}$, where H_0 is the field at atmospheric pressure. The center of gravity of the spectrum shifts with pressure indicating an increase in s electron density at the nucleus. The initial variation, -8.3×10^{-5} cm sec^{-1} $kilobar^{-1}$, is consistent with scaling the 4s wavefunction with volume while at higher pressures the variation is slower. Above 133 kilobars a seventh line appears near the center of the spectrum due to the transformation of part of the iron source to the hexagonal-close-packed high pressure phase. With increasing pressure this line becomes more intense and the split spectrum disappears although the transformation is sluggish. From the absence of splitting and from the observed linewidth it was concluded that the internal field in the hexagonal phase is (0 ± 3) kilogauss. There may be a small broadening due to electric quadrupole interactions in the hexagonal lattice. The isomer shift of the hexagonal phase relative to the cubic phase is –0.017 cm/sec (s electron density greater in hexagonal phase). The pressure dependence of the shift in the hexagonal phase is very slight and is not consistent with scaling the 4s wavefunction with volume. Apparatus and experimental techniques that were developed for measuring the Mössbauer spectra of sources under pressure are described. (Dissertation Abstr.)

43497 DYNAMIC POLARIZATION OF SODIUM IN SODIUM CHLORIDE CONTAINING Cl_2^- CENTERS (thesis). Hill, John Joseph. St. Louis, St. Louis Univ., 1964. 146p.

By use of double resonance techniques and a low level NMR oscillator-detector, the ^{23}Na nuclear magnetic resonance signal in a sample of monocrystalline NaCl at 77°K was successfully enhanced by a factor of from 2 to 8 both positively (power absorbed) and negatively (power emitted) by means of the solid effect. This was accomplished by saturating electron spin resonance lines corresponding to forbidden transitions of Cl_2^- molecular ions, introduced by 65-kv x irradiation of 1000 to 2000 R. In applying the saturation theory to the ^{23}Na enhancement data, the line width, relative saturability, T_1, and T_2 were obtained for the invisible forbidden transition. The line width of the forbidden EPR transition associated with the Cl_2^- center was calculated to be 1.67 ± .3 gauss from the positive enhancement data and 1.84 ± .3 gauss from the negative enhancement data. The width is equal within experimental accuracy to the ^{23}Na NMR line width but different from the width of the allowed EPR transition. The relaxation times for the forbidden transition were calculated to be T_1 = 2.3 μsec and T_2 = .043 μsec from the negative enhancement data and T_1 = 3.5 μsec and T_2 = .042 μsec from the positive enhancement data. These values are quite different from those of the allowed transition for which T_1 = 90 μsec and T_2 = .015 μsec. With this information it was then pos-

sible to predict the observed variation of enhancement with applied microwave power. By estimating the number of Cl_2^- centers present in the sample, the number of ^{23}Na nuclei polarized per Cl_2^- center was calculated and found to be quite large, of the order of 10^6. It was also found that the enhanced nuclear signal grew under application of power and decayed back to the unenhanced value with the same decay time of 59 sec within experimental error. The data then indicate the presence of spin diffusion or diffusion of the polarization to about 50 interionic distances from the Cl_2^- center. (Dissertation Abstr.)

43498 MAGNETIC RESONANCE STUDIES OF REACTOR-IRRADIATED POTASSIUM BROMIDE (thesis). Greene, Alan Campbell. Providence, Brown Univ., 1964. 193p.

Nuclear magnetic resonance and electron-spin resonance studies of reactor-irradiated crystals of KBr were carried out and interpreted. For sample irradiations, the γ irradiation is much more efficient in producing atomic displacement than is the fast neutron flux. The number of measured halogen-ion displacements exceeds that predicted by theories of fast neutron displacement production by a factor of 50. There is a good numerical correspondence between the number of defects measured using both resonance techniques. As measured by changes in the ^{79}Br NMR spectra, the interstitial formation rate for high doses corresponds to the measured F-center spin formation rate observed for lower doses. However, at the higher doses, extensive clustering of the F-center is observed. Isochronal thermal annealing studies conducted on the heavily irradiated crystals indicate that there is no simple process for the F-center-interstitial recombination. The observed F-center spin concentrations anneal quite rapidly between temperatures of 100 and 150°C, whereas the interstitial system does not recombine with the vacancy system until temperatures in excess of 200°C have been attained. These results indicate that the interstitial recombines with F-center agglomerates, rather than with isolated F-centers. (Dissertation Abstr.)

43499 INELASTIC SCATTERING OF NEUTRONS BY ANHARMONIC CRYSTALS (thesis). Conway, John Michael. Ithaca, N. Y., Cornell Univ., 1964. 190p.

An explanation of the line shape of the scattered intensity of the neutrons is given. The starting point of the calculation is the space and time Fourier transform of the correlation of two density fluctuation operators. For the harmonic crystal with fixed momentum transfer the scattering cross section has perfectly sharp peaks above a diffuse background at the frequencies of those phonons of wave vector q whose polarizations are not perpendicular to q. The experimentally observed peaks have widths greater than the experimental uncertainty which indicates the harmonic approximation is too crude and that the anharmonic terms in the hamiltonian must be incorporated into the calculation. A formally exact linked cluster or semi-invariant perturbation expansion of the scattering intensity is given. It is possible to interpret the terms of the expansion as the creation and interaction of various phonons. To simplify matters the remaining analysis is carried out for a Bravais lattice with no electron phonon interaction. It is then shown that, in the regions of the single phonon energy, only three processes make major contributions to the rapid variations of the scattered intensity. These processes are: the creation of a single dressed phonon, the creation of two dressed phonons which coalesce into a single dressed phonon, and the decay of a single dressed phonon into two dressed phonons. These last two processes are interference effects between a single phonon and two phonons. They are represented in the perturbation expansion as "Y" diagrams. The interference terms contribute an asymmetric term to the scattering intensity which has the effect of shifting the resonance from the one phonon frequency and changing the line shape from an expected Lorentzian form. Quantitative calculations of the decay rate and the asymmetric contribution to the scattering intensity are made using a simpie model for the phonon system. The model chosen is a monatomic Bravais crystal with a Debye lattice spectrum consisting of one longitudinal and two transverse modes, and a cubic anharmonic perturbing potential. The conditions necessary for the asymmetric terms to make a large contribution to the line shape are discussed. (Dissertation Abstr.)

43500 PHONON BROADENING OF NARROW LINE SPECTRA. Silsbee, R. H. (Cornell Univ., Ithaca, N. Y.). pp 773-8 of Quantum Electronics. Proceedings of the 3rd International Congress, Paris, 1963. New York, Columbia University Press, 1964. (NYO-2150-5).

A qualitative interpretation of phonon broadening of spectral lines in solids is presented. The F-center in KCl, the Mössbauer effect for ^{57}Fe, and the narrow R lines in ruby are considered as specific examples. (D.C.W.)

REACTOR TECHNOLOGY

General

Refer also to abstracts 42682, 42691, and 42956.

43501 (BMI-X-10133) AN EVALUATION OF THE APPLICABILITY OF EXISTING DATA TO THE ANALYTICAL DESCRIPTION OF A NUCLEAR-REACTOR ACCIDENT. Quarterly Progress Report, April–June 1965. Sunderman, Duane N.; Morrison, David L.; Gieseke, James A.; Smith, John C.; Walters, Craig T. (Battelle Memorial Inst., Columbus, Ohio). July 1, 1965. Contract W-7405-eng-92. 22p. (EURAEC-1425). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Work Performed under United States–Euratom Joint Research and Development Program.

Development of a digital-computer program (NURLOC) for the analytical description of heat transfer and thermodynamics of a loss-of-coolant accident was continued. Finite-difference forms of the two-dimensional transient-heat-transfer equations were programmed and incorporated into a computational scheme which provides for scanning of the reactor geometry and the calculation of temperatures at finite time steps in the accident sequence. A computer subroutine was written to alter the heat-generation rates according to fission-product-decay characteristics. Consideration was given to a simplified description of coolant disposition and its interaction with the heat transfer in the initial version of NURLOC. A continuing evaluation was made of experimental results on the release of fission products from UO_2 fuel for application to the analysis of fission-product behavior in the loss-of-coolant accident. The studies reported deal chiefly with the rare gasses in the temperature realm where simple diffusion is assumed to apply. Effects anomalous to simple diffusion theory are still an analytical consideration. Extrapolation of rare-gas-diffusion behavior will be required to provide information about other fission products of interest in the diffusion-controlled temperature-range. Experimental results from fuel-melt-down and fission-product-release studies were examined for information on the rare gases, iodine and ruthenium. The releases of these species from the fuel and hot zone were summarized for different claddings, atmospheres, atmosphere flow rates, heating methods, and durations of melting. Fission-product-release rates under such conditions are needed for a realistic analysis of fission-product behavior in the loss-of-coolant accident. The formation and growth of aerosol particles were reviewed. It was determined that either experimental data for particle size and information rate or a heterogeneous nucleation model will provide the necessary input for a model to predict particle growth, transport, and deposition. A heat-mass transfer analogy appeared to be most suitable for predicting fission-product deposition. (auth)

43502 (ORNL-3782, pp 102-14) REACTOR INSTRUMENTATION AND CONTROLS ANALYSIS. (Oak Ridge National Lab., Tenn.).

Information is presented concerning determination of reactor parameters by spectral-density measurements, analog null methods for determining frequency responses of large linear systems, simulation of hot-spot heat flux in the High Flux Isotope Reactor, and count-rate requirements in fast-burst reactors. Descriptions of MSRE control system modes, MSRE heat removal rate controller, and computer models of MSRE are included. (J.R.D.)

43503 (ORNL-3782, pp 115-39) REACTOR INSTRUMENTATION AND CONTROLS DEVELOPMENT. (Oak Ridge National Lab., Tenn.).

Progress on development of process instrumentation is reported along with development progress on wide-range counting instruments. Operational testing of ORR safety system response-time measuring equipment is discussed. Design and developmental work is reported on coincidence electromagnets for reactor safety, HFIR fuel-element channel-width gages, HFIR fuel-plate scanners, and pneumatic print-out devices. (J.R.D.)

43504 HEAVY WATER REACTOR REVIEW AND PROSPECT. Lewis, W. B. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. Nucl. Technol., 4: 46-50 (July 1965). (DL-67).

At present the heavy water reactor alone belongs both to the proven and the advanced converter classes. It could also be pushed into the breeder class. It challenges all reactors including breeders, as an economic generator of electricity or process heat for desalination or other large uses. It is an efficient converter requiring only a very small inventory of fuel. It is so flexible in its fuel cycle that the choice can be made a question of the current market situation. When it is no longer cheapest to fuel with natural uranium, plutonium could be recycled or separated uranium-235 or plutonium could give entry to the thorium–uranium-233 cycle. Recent designs for 500 Mw(e) for early construction show a heavy water inventory of about 0.5 kg D_2O/kw(e) costing about $15/kw(e) at the anticipated price of D_2O in 6 years' time of $13.50 U. S./lb ($30/kg). Engineering ingenuity and experience promise to reduce capital costs so that heavy water reactors may soon become fully competitive in capacities down to 80 Mw(e). All along the special feature of D_2O reactors has been and will remain the low fuelling cost based on good neutron economy. The choice of coolant for long and trouble-free operation is providing good competition for the designers. Heavy water as a coolant possesses advantages that can be exploited both in pressure-tube and pressure-vessel reactors. The advent of prestressed-concrete pressure containers has enlarged the prospects of the latter. In pressure tubes, CO_2 gas, boiling H_2O, superheated steam, and organic liquids provide alternatives. To maintain neutron economy with these coolants the fuel inventory may be somewhat increased and the pressure-tube wall thickness reduced by special techniques. The organic and gas coolants may use carbide instead of oxide fuel and benefit from the higher density and thermal conductivity. Steam and boiling H_2O have to contend with the corrodibility of the strongest neutron-economical zirconium alloys. The choice and design specifications adopted are based on empirical results just as in other reactor types, because the science of materials under stress at high temperature under irradiation and subject to corrosion is still only embryonic. The desirable scientific research is very costly, but given support and cooperation, there is reason to hope for major improvements. (auth)

43505 GAS CONTROL OF NUCLEAR REACTORS. Alekseev, G. N. (All-Union Correspondence Polytechnic Inst., USSR). Inzh.-Fiz. Zh., Akad. Nauk Belorussk. SSR, 8: 525-7(Apr. 1965). (In Russian)

A gaseous neutron absorber should not condense out at a pressure of about 8×10^6 n/m^2, and should be stable at high temperatures in a strong gamma field. It is noted that various boron hydrides are unstable above 150 to 200°C. The most suitable gaseous neutron absorbers at present are BCl_3, BF_3, ^3He, and Gd and Sm in the form of aerosols. The macroscopic absorption cross sections at 9.81×10^6 n/m^2 and 20°C are in barns/100m: 2070 for BCl_3, 1834 for BF_3, and 12,500 for ^3He. The values are a factor of 5 higher if enriched ^{10}B is used in the compound. Approximate calculations show that the diameter of the gas tube required to replace the solid control rod is comparable to the diameter of the channel used for the solid rod. (TTT)

43506 SELECTED RESULTS OBTAINED IN THE REACTOR EXPERIMENTAL STATION AT GARCHING. Engler, Hans Dietrich. Siemens-Z., 39: 531-7(May 1965). (In German).

The development of a method for the accurate determination of reactivity (suitable for power reactors), the development of a reactor oscillator for the Siemens training reactor, and the determination of the short-range order in Fe–Ni alloys by means of the Mössbauer effect are reported. (D.C.W.)

43507 TRANSACTIONS OF THE AMERICAN NUCLEAR SOCIETY REACTOR OPERATIONS DIVISION MEETING, JULY 28-29, 1965, JACKSON LAKE LODGE, WYOMING. CONFERENCE ON REACTOR OPERATING EXPERIENCE. Trans. Am. Nucl. Soc., 8: Suppl., 1-56(1965). (CONF-650710).

Summaries of 64 papers are included. Each paper is title listed in NSA. (C.E.S.)

For titles of individual papers see: 43508–43513, 43516, 43526–43527, 43555–43578, 43581–43585, 43592–43594, and 43600–43622.

43508 IDAHO DIVISION REACTOR OPERATIONS PERSONNEL TRAINING PROGRAM. Bryant, H. (Argonne National Lab., Idaho Falls, Idaho). Trans. Am. Nucl. Soc., 8: Suppl., 15-16(1965).

43509 REACTOR SAFETY REVIEW ORGANIZATION. Larson, H. J. (General Electric Co., Pleasanton, Calif.). Trans. Am. Nucl. Soc., 8: Suppl., 16-17(1965).

43510 THE CONTRIBUTION OF SYSTEMATIC INCIDENT EVALUATION TO THE ACHIEVEMENT OF REACTOR SAFETY. Ablitt, J. F. (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). Trans. Am. Nucl. Soc., 8: Suppl., 17-19(1965).

43511 REACTOR SAFETY AT AEC-OWNED FACILITIES. McCool, Whittie J. (Atomic Energy Commission, Germantown, Md.). Trans. Am. Nucl. Soc., 8: Suppl., 19 (1965).

43512 CONTROL OF REACTOR MODIFICATIONS FOLLOWING COMMISSIONING. Corlett, Richard F. (Battelle-Northwest, Richland, Wash.). Trans. Am. Nucl. Soc., 8: Suppl., 19-20(1965).

43513 SAFETY ACHIEVEMENT IN THE STARTUP AND INITIAL OPERATION OF 18 REACTORS. Haaga, J. A.; Ascherl, R. J.; Christianson, R. C.; Hamilton, R. B.; Willett, D. K. (International General Electric Operations, San Jose, Calif.). Trans. Am. Nucl. Soc., 8: Suppl., 33-4 (1965).

Auxiliaries and Components

43514 (ORNL-tr-601) NUCLEAR REACTOR CONTROL RODS. Walker, David E.; Matras, Steve. Translated for Oak Ridge National Lab., Tenn., from Japanese Patent 413,628. Aug. 15, 1963. 6p. Dep. mn; JCL, $1.10 fs, $0.80 mf.

A nuclear reactor control rod is described which contains boron in the core and two porous plugs made of closely packed metallic wool in both ends, so that it allows helium gas to escape from the core but tightly seals out the liquid sodium. (M.O.W.)

43515 LOOPS FOR HEAT AND FLOW TESTS AND TECHNOLOGICAL TRIALS IN THE DEVELOPMENT OF POWER REACTORS. Kahlert, Wolfgang. Siemens-Z., 39: 518-25(May 1965). (In German).

In the development and design of power reactors, it is also necessary to carry out many tests and trials in the field of conventional machines and apparatus. This calls for the provision of test loops which permit actual reactor heat conditions, flow conditions, and operating processes to be simulated without radiation influence. A description is given of the purpose and design of such loops. (auth)

43516 SAFETY SYSTEM PERFORMANCE FAILURES. Epler, E. P. (Oak Ridge National Lab., Tenn.). Trans. Am. Nucl. Soc., 8: Suppl., 49-50(1965).

43517 FUSE DEVICE FOR A NUCLEAR REACTOR. Brynsvold, G. V.; Hikido, K. (to U. S. Atomic Energy Commission). U. S. Patent 3,205,149. Sept. 7, 1965.

A description is given of fuse elements for use in nuclear reactors, which comprises two coupling members slideably arranged with a fuse pin arranged there between under compression to restrain the motion of safe operating levels and such that plastic flow deformation rather than full melting of the pin at elevated temperatures permits sliding motion between the coupling members to motivate a reactivity control element to decrease nuclear reactivity. (AEC)

Criticality Studies

See also PHYSICS — Criticality Studies.

43518 (IAE-844) IZUCHENIE ^{235}U + Be PODKRITICHESKIKH SBOROK IMPUL'SNYM METODOM. (Study of ^{235}U Be Subcritical Assemblies by the Pulse Method). Zhezherun, I. F. (Institut Atomnoi Energii, Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1965. 28p. Dep. mn.

Results of tests on nearly homogeneous ^{235}U-Be thermal neutron assemblies, with the intent of directly obtaining reactor parameters in the age and two-group approximations as well as checking the method of multigroup calculations, are presented. The assemblies were combined in the form of a cube or a parallelopiped close to a cube from alternate plane layers of Be and ^{235}U. The coefficient of time decay α of the basic harmonic of neutron density in more than 30 assemblies of various dimensions (from nearly critical to very subcritical) was measured by the pulsed-neutron-source method. Analysis of the variation of the α with the geometrical parameter of the assembly was carried out using a well-known formula. The average velocity of the thermal spectrum in large assemblies was also measured in comparison with the average velocity in moderator blocks of equal size. (tr-auth)

43519 (WCAP-6069) BURNUP PHYSICS OF HETEROGENEOUS REACTOR LATTICES. Poncelet, Claude G. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). June 1965. Contract AT(30-1)-3017. 182p. Dep. mn; CFSTI $5.00 cy, $1.00 mn.

A method is developed for the calculation of fuel burnup in a heterogeneous reactor lattice cell. The method accounts for all non-linearities and mutual connections in the system of equations consisting of the transport equation for the flux and the isotopic depletion equations. The model is based on a multi-energy (85) group calculation based on the integral transport equation in the thermal energy range (THERMOS) and the P-1 approximation (MUFT) in the epithermal and fast energy ranges. The spatial distribution of epithermal resonance reaction rates is calculated by the Monte Carlo technique. The thermal energy cut off is 1.855 ev. The method consists in calculating the neutron flux in space and energy as a function of time, and introducing this time-dependent flux into the isotopic depletion equation to obtain the fuel composition as a function of time. The solution of these equations is put into the form of matrices, the elements of which are isotopic reaction rates or functions of reaction rates based on unit isotopic concentrations. Each isotope in an irradiation chain is thus assigned a characteristic burnup vector and a characteristic burnup matrix. The method is programmed in the FORTRAN IV language for the IBM 7094 computer. The code, called LASER, calculates the spatial distribution of the neutron flux spectrum and the fuel composition as a function of burnup in a lattice cell, as well as reaction rates and effective cross sections for the cell. Results of calculations for a Yankee Core fuel cell are described. The calculations are compared with experimental data from the Yankee core for burnups ranging to 25,000 MWD/MTU. Comparisons are made with measurements of the radial distribution of the fuel composition in depleted fuel rods. The calculations and measurements generally agree. (auth)

43520 NEUTRONIZATION OF ^4He. Zel'dovich, Ya. B.; Guseinov, O. Kh. JETP Letters (USSR)(English Transl.), 1: 109-12(May 15, 1965).

The reaction $e^- + {}^4He \rightarrow T + N + \nu$, followed by the reaction $e^- + T \rightarrow 3n + \nu$, is studied with particular consideration of the energy of the neutrinos emitted. (D.C.W.)

43521 CRITICALITY OF HOMOGENEOUS PLUTONIUM OXIDE-PLASTIC COMPACTS AT H : Pu = 15. Richey, C. R.; White, J. C.; Clayton, E. D.; Lloyd, R. C. Nucl. Sci. Eng., 23: 150-8(Oct. 1965). (BNWL-SA-184).

Critical experiments were conducted with homogeneous mixtures of PuO_2-polystyrene (H : Pu atomic ratio of 15) containing both 2.2 and 8.0% ^{240}Pu. Criticality was determined for a series of Plexiglas reflected rectangular prisms ranging from near cubes, to long columns, and to thin slabs; bare arrays of near-cubic geometry were also studied. Critical thicknesses were 16.09 ± 0.41 and 5.99 ± 0.10 cm, respectively, for the bare and reflected infinite slabs of PuO_2-polystyrene containing 2.2% ^{240}Pu. Corresponding values for the 8.0% ^{240}Pu mixtures were 18.48 ± 0.41 and 7.38 ± 0.09 cm. The infinite slab thicknesses for an equivalent ^{239}Pu-water mixture (H : Pu = 15, ρ = 1.62 g Pu/cm^3) were 11.66 ± 0.30 and 4.38 ± 0.08 cm, respectively, for the bare and water-reflected slabs. Corresponding critical radii for infinitely long cylinders were 10.52 ± 0.16 and 6.54 ± 0.14 cm; radii for critical spheres were 13.81 ± 0.16 and 10.40 ± 0.17 cm. (auth)

43522 NEW APPROXIMATE SOLUTION OF SPACE- AND ENERGY-DEPENDENT REACTOR KINETICS. Hoshino, Tsutomu; Wakabayashi, Jiro; Hayashi, Shigenori. Nucl. Sci. Eng., 23: 170-82(Oct. 1965).

An expression different from the conventional modal expansion about space-dependent linear system kinetics is proposed. The solution is expressed in the form of a Laplace-transformed source transfer function. The Taylor expansion of the function in "s" (the variable in the transformed domain) is obtained by solving the related stationary equations. The series is approximately continued to the simple form of the transfer function such as the first-order lag or the transport lag expression. In this method, it is not necessary to solve the eigenvalue problem directly. This solution contains the contribution from the higher modes and gives a practical approximation in a simple form, even if the response includes much higher modes. A numerical example is shown. This method is also applicable to general linear distributed constant systems. Some applications to coupled reactor theory and to thermalization kinetics are mentioned. (auth)

43523 A SIMPLIFIED NONLINEAR MODEL FOR QUALITATIVE STUDY OF REACTOR POWER-DISTRIBUTION TRANSIENTS. Hurwitz, H. Jr. Nucl. Sci. Eng., 23: 183-7(Oct. 1965).

Because of the large physical size of typical boiling-water power-reactor cores, there is a possibility of transients in the spatial power distribution. The vertical coolant flow produces a strong unidirectional coupling between the power in the lower and upper parts of the core. This situation is qualitatively analyzed by means of a highly simplified two-node reactor model. The additional assumption that the effective delayed-neutron period and fuel-element thermal time constant are equal makes possible a nonlinear graphical solution of the problem by the parametric trajectory method. In the illustrative numerical examples, the spatial power-distribution transients are mild. (auth)

43524 NUCLEAR-FUEL-DEPLETION MEASURING DEVICE. Freeman, L. B. (Westinghouse Electric Corp., West Mifflin, Penna.). Nucl. Sci. Eng., 23: 188-9(Oct. 1965). (WAPD-T-1714(Rev.).

A combination of a ^{235}U miniature fission counter and a ^{238}U miniature fission counter can possibly be used to measure approximately the fuel fraction remaining in a reactor core at any time without waiting until the end of core life, and without destructive testing according to calculations. Under certain rather generally occurring conditions in a large thermal reactor fueled with highly enriched ^{235}U, the fast-neutron flux at a point is proportional to the fission density in the vicinity of the point. In particular, an axial flux measurement tube is considered with the fast neutron flux along the tube at a given time. Conditions which are sought are those under which the fast neutron flux will be approximately proportional to the fission density in a region about the flux tube. The conditions are that the fast-group-diffusion constant and macroscopic absorption and removal cross sections, in the vicinity of the flux tube, should be approximately constant in time and in axial position along the flux tube, and that the fast leakage should be small or proportional to the fast flux. The results show promise for this type of measurement, under the given conditions. (J.F.P.)

43525 REGENERATING IN-CORE NEUTRON-FLUX CHAMBERS. Bunch, W. L.; Wood, M. R. (Battelle-Northwest, Richland, Wash.). Trans. Am. Nucl. Soc., 8: Suppl., 23(1965).

43526 EXPERIMENTAL INVESTIGATION OF DEPARTURE FROM NUCLEATE BOILING. Schmitt, R. C.; Toole, C. R. (Phillips Petroleum Co., Idaho Falls, Idaho). Trans. Am. Nucl. Soc., 8: Suppl., 24-5(1965).

43527 DESIGN CONSIDERATIONS IN SAFETY ANALYSIS OF PARTIAL MODERATOR-LEVEL CONTROLLED REACTORS. Hamilton, G. N.; Taylor, E. G.; Hanlen, D. F. (Westinghouse Electric Corp., Madison, Penna.). Trans. Am. Nucl. Soc., 8: Suppl., 49(1965).

Design and Feasibility

43528 HIGH TEMPERATURE REACTOR WITH SPECIFIC DISTRIBUTION OF NON-1/v ABSORBER AND FERTILE MATERIAL. Stewart, Hugh B.; Leshan, Edward J. (to U. S. Atomic Energy Commission). U. S. Patent 3,205,139. Sept. 7, 1965.

A high temperature nuclear reactor is described wherein the reactivity is controlled by the particular placement of non-1/v neutron poison material and fertile material in the core; the poison material being more concentrated near the axis in the regions near the top of the core, and the fertile material being more concentrated near the periphery in the regions near the bottom of the core. These materials are present in sufficient quantity to provide a substantial prompt negative contribution to the temperature coefficient of reactivity. (AEC)

Fuels

43529 PLUTONIUM NUCLEAR REACTORS. Bucci, Pompeo (CAMEN, Pisa, Italy). Ing. Nucl., 6: 69-91 (Mar.-Apr. 1965). (In Italian).

The present declassified data on the physical characteristics of Pu and on its utilization in fast and thermal reactors are summarized. The physical and technological aspects are given. (J.S.R.)

43530 FUEL ELEMENT ASSEMBLY FOR SUPERHEATING VAPOR IN A BOILING COOLANT NUCLEAR REACTOR. Ammon, Johannes H. (to The Babcock and Wilcox Co.). Canadian Patent 709,493. May 11, 1965. Priority date Dec. 1, 1960, United States.

A fuel element assembly for a boiling reactor is described. The vapor from the coolant is separated from the liquid and superheated by recirculating through the fuel element assembly and is then used to rotate the turbines. Each fuel element assembly boils the vaporizable coolant, then separates and superheats the vapor, thereby eliminating the necessity for a special zone in the core or an entirely separate unit for superheating. (F.S.A.)

43531 NUCLEAR REACTOR FUEL MANAGEMENT METHOD. Jaye, Seymour; Lee, Dana H. Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,208,912. Sept. 28, 1965.

A method of fuel management is presented for a power-breeder nuclear reactor utilizing a thorium–uranium fuel cycle. The reactor is charged with fuel units containing uranium and thorium and operated for the desired reactivity life of at least a selected portion of the fuel units which are reprocessed to substantially eliminate fission products neptunium and uranium-236. The fissile nuclides and thorium along with make-up enriched uranium are returned to the reactor for a subsequent reactor cycle. (AEC)

43532 FUEL ELEMENT FOR A NUCLEAR REACTOR. Hennig, Robert J.; Aase, Duane T. (to U. S. Atomic Energy Commission). U. S. Patent 3,208,916. Sept. 28, 1965.

A prism shaped fuel element is designed for a fast nuclear reactor wherein the outermost cooling tubes form part of the outside wall which eliminates the need for an auxiliary cooling system to cool the outside of the fuel element. (AEC)

Power and Power-Breeder Reactors

43533 OYSTER CREEK BWR SETS 4-MILL TARGET. Kregg, D. H. (Burns and Roe Inc., New York); Koke, L. C.; Rees, D. R. Elec. World, 163: 87-90(June 14, 1965).

The boiling-reactor plant under construction for the Jersey Central Power and Light Co. is described. A plant investment of $104/kw and a total power cost under 4 mill/kw-hr at the 640-Mw(e) gross rating are estimated for the plant. Factors contributing to the plant's low cost are outlined, and the status of the plant is summarized. (D.C.W.)

43534 CONNECTICUT YANKEE ADVANCES PWR CONCEPT. Vandenburgh, D. E. (Connecticut Yankee Atomic Power Co., Boston); Woodman, W. C.; Yadon, J. M. Elec. World, 163: 91-4(June 14, 1965).

The second nuclear power plant to be built by Connecticut Yankee Atomic Power Co., a 462-Mw(e) unit scheduled for completion late in 1966, is described with emphasis on variations from the design of the first power plant. Estimates of capital requirements and power costs are included. (D.C.W.)

43535 WORLD SURVEY STATISTICS OF 84 UNITS. Elec. World, 163: 95-104(June 14, 1965).

The specifications and economic factors for 84 power reactors throughout the world are tabulated. (BBB)

43536 THE PERFORMANCE OF COMMERCIAL NUCLEAR POWER STATIONS IN THE UNITED KINGDOM, SYMPOSIUM HELD AT THE UNIVERSITY OF LEICESTER, [ENGLAND], ON 30 JUNE 1965. J. Brit. Nucl. Energy Soc., 4: 169-243(July 1965). (CONF-650642).

Individual abstracts were prepared for the 6 papers presented. (M.O.W.)

For abstracts of individual papers see: 43537–43542.

43537 THE EVOLUTION OF MAGNOX STATION DESIGN. Carruthers, H. M. J. Brit. Nucl. Energy Soc., 4: 171-80(July 1965).

The development of the magnox concept from the start of the commercial nuclear program is traced. Particular attention is paid to the influence on core design of the increasing knowledge of graphite behavior under irradiation and to the very large extrapolations of in-pile data necessary in the early stages of the program. Successive improvements in layout, shielding, refueling methods, pressure circuit technology, and fuel element design are described, and the resulting advances in performance are discussed. (auth)

43538 THE EVOLUTION OF COMMISSIONING OF NUCLEAR POWER STATIONS. Heath, C. D.; Silverleaf, D. J. J. Brit. Nucl. Energy Soc., 4: 181-95(July 1965).

The objectives of commissioning work for commercial nuclear power stations are examined and the possible approaches to planning and organizing the implementation of this work are discussed. The history of commissioning at Berkeley and Bradwell is briefly reviewed and assessed against the stated criteria. Subsequently, a description and justification is given of the major changes in the current programs from those for the original stations, and the current methods of working are also briefly described. (auth)

43539 PERFORMANCE OF REACTOR CORES AND MATERIALS. Barden, S. E. J. Brit. Nucl. Energy Soc., 4: 197-216(July 1965).

The performance to date of the reactor core and core materials of the first two civil magnox nuclear power reactors is described, and related to design expectations of both initial and ultimate performance. The general conclusions drawn from operational experience are very encouraging. In most respects the behavior of core materials was better than expected. This is more true of fuel elements than of other core materials, as a result of which fuel lifetime limits were recently revised upwards by 20%. (auth)

43540 THE PERFORMANCE OF NUCLEAR POWER STATION PLANT. Evans, D. T.; Jones, F. R. R.; Prior, W. J. J. Brit. Nucl. Energy Soc., 4: 217-26(July 1965).

Of the nine civil nuclear stations, Berkeley, Bradwell, and Hunterston are fully operational. An examination of the performance of these three stations is presented. The reasons for non-availability are discussed and an effort was made to compare and contrast the designs of the stations. Because of the difficulties experienced at Bradwell and Berkeley with refueling, a section on fueling is included. The flexibility in operation of the stations is described and prospects for the future are reviewed. (auth)

43541 NUCLEAR POWER STATION MAINTENANCE. Mears, G. A.; Thomas, T. J. Brit. Nucl. Energy Soc., 4: 227-36(July 1965).

A nuclear power station consists of high merit plant which is expensive to replace in a power system. The maintenance requirements of such a plant must be critically examined in order to reduce loss of output to a minimum. At the present, statutory survey requirements are the principal continuing cause of loss of availability, and experience shows that they could be considerably reduced with safety. Availability can be improved by good planning and the development of efficient maintenance systems. In a nuclear power station, health physics requirements play a large part in maintenance planning and in this respect future stations should be better planned and equipped for maintenance of radioactive equipment. (auth)

43542 SPECIAL PROBLEMS IN THE OPERATION OF NUCLEAR POWER STATIONS. Holbrook, P. H. G.; Horne, A. C. J. Brit. Nucl. Energy Soc., 4: 237-43(July 1965).

The nuclear generating stations of the CEGB are operated within a framework constructed from the normal industrial legislation together with the provisions of the Nuclear Installations Licensing and Insurance Act 1959, the Radioactive Substances Act, and the Board's own safety regulations. Arrangements are made to ensure that the safety standards are maintained. The pattern of station organization is similar to the one used for conventional power stations, but it is augmented by appropriate specialists. The increased automation of future stations may lead to a change in the pattern. (auth)

43543 ADVANCED STEAM CONDITIONS ARE JUSTIFIED FOR NUCLEAR POWER PLANTS. PART ONE. Fiehn, A. J.; Schoenwetter, Henry D. (Burns and Roe, Inc., New York. N. Y.). Power Eng., 69: 48-50(Feb. 1965).

A study made of the thermodynamics and economics of improved steam conditions and estimates of their effect on future nuclear steam power cycles showed that raising steam pressure to 2000 psig gives a steady increase in economic advantages. The basis for this study is a steam plant with a gross generation of 539.6 Mw. Power stretch of up to 670 Mw gross is allowed for by designing the

steam turbine generator and its auxiliaries for the increased output. The reactor was designed to produce steam for 539,600 kw gross, but may produce more steam as a result of design margins and expected advances in technology. Analysis indicated that at all fixed charge rates there is a definite incentive to use higher-pressure steam conditions. For example, a fixed charge rate of 5%, the savings in going from 1000 psig saturated steam to 1500 psig saturated steam is $426,100/yr; the savings in going from 1000 psig to 2000 psig saturated steam is $562,900/yr. At 10% and 15% fixed charge rates, these savings over the 1000 psig base case increase further. It is concluded that at all fixed charge rates there is a considerable advantage in increased steam pressures. With regard to steam temperature, the advantages of going to higher superheating are not so clear-cut. The present state of reactor development indicates that, with increases in the amount of superheating, the thickness of cladding on the fuel elements must also be increased. The cladding presently under consideration for the higher steam temperatures acts to increase parasitic losses of neutrons and consequently requires greater fuel enrichment. The cost of this fuel enrichment tends to counteract the thermodynamic benefits derived from the improved steam conditions. The results of a study of increased steam temperatures show that there is some gain in going to limited amounts of superheating. These gains, however, tend to decrease the finally disappear with larger increases in superheating. (BBB)

43544 POWER REACTOR TECHNOLOGY. Volume 8, Number 1. Zinn, Walter H.; Dietrich, J. R. (General Nuclear Engineering Corp., Dunedin, Fla.). Winter 1964-1965. $0.70(GPO) (domestic), $0.90(GPO) (foreign). (One of the Technical Progress Reviews prepared quarterly for the Division of Technical Information, USAEC). 111p. Dep.

Ten sections are included; separate abstracts have been prepared for all. (T.F.H.)

For abstracts of individual sections see: 43545—43553, and 43590.

43545 BOILING AND PRESSURIZED LIGHT-WATER REACTORS. Wiley, John S. Power Reactor Technol., 8: No. 1, 3-21(Winter 1964-65).

Operating experience and future developments in boiling and pressurized-light-water reactors are surveyed. Recent developments in fuel systems, control systems, cooling systems, pressure vessels, and thermal and hydraulic design of these types of reactors are also reviewed. (T.F.H.)

43546 VESSEL TYPE SUPERHEATING REACTORS. Power Reactor Technol., 8: No. 1, 22-7(Winter 1964-65).

The status and design characteristics of the BONUS, Pathfinder, BORAX-V, Kahl, EVESR, and Ulyanovsk pressure-vessel superheating reactors are reviewed. (T.F.H.)

43547 GRAPHITE-MODERATED SUPERHEATING REACTORS. Power Reactor Technol., 8: No. 1, 28-34 (Winter 1964-65).

The design characteristics and operating history of the Russian graphite-moderated steam-superheating power reactor at Beloyarsk are reviewed. The characteristics of a second reactor (Beloyarsk 2) of this type, under construction at the same site, are also outlined. (T.F.H.)

43548 HEAVY-WATER-MODERATED PRESSURE-TUBE REACTORS. Power Reactor Technol., 8: No. 1, 35-46(Winter 1964-65).

Operating experience; developmental studies on fuel and cladding materials, D_2O chemistry, pressure tubes, and thermal-hydraulic characteristics; and developmental programs are surveyed for a D_2O-moderated pressure-tube reactors, with emphasis on experiences in CANDU, NPX, NRX, and NRU. (T.F.H.)

43549 HEAVY-WATER-MODERATED PRESSURE-VESSEL REACTORS. Power Reactor Technol., 8: No. 1, 47-57(Winter 1964-65).

The general status of the Agesta, Halden, and Markiven reactors, and the Czechoslovak nuclear power station of the heavy-water-moderated pressure-vessel type, is reviewed. Developments in fuel elements, cladding, and materials; water chemistry; control and instrumentation; and pressure vessels for these reactors are described. (T.F.H.)

43550 GAS-COOLED CLAD-FUEL REACTORS. Mitchell III, Walter. Power Reactor Technol., 8: No. 1, 58-71(Winter 1964-65).

Development of fuel elements, pressure vessels, refueling machines, control and instrumentation, and advanced concepts of clad-fuel gas-cooled power reactors are reviewed. The program status is outlined. (T.F.H.)

43551 GAS-COOLED UNCLAD-FUEL REACTORS. Power Reactor Technol., 8: No. 1, 72-4(Winter 1964-65).

The developmental status of HTGRE and Peach Bottom Power Reactor is reviewed. (T.F.H.)

43552 SODIUM-COOLED REACTORS. Dietrich, J. R. Power Reactor Technol., 8: No. 1, 75-96(Winter 1964-65).

Liquid sodium systems are studied from the viewpoints of fission-product retention, liquid-sodium uses and handling, and components for use in liquid-sodium-cooled reactors. The status, operations, fuels, economics, and development of sodium-graphite and sodium-cooled fast breeder reactors are reviewed. (T.F.H.)

43553 OTHER REACTORS. Power Reactor Technol., 8: No. 1, 103-7(Winter 1964-65).

Descriptions are given of several SM and PM Army reactors, the Russian organic-moderated portable ARBUS reactor, the Russian pressurized-water reactor TES-3, SNAP-10A and the Russian Romashka direct-conversion reactors, MSRE, EBOR, UHTREX, and FRCTF. (T.F.H.)

43554 OBJECTIVES OF REACTOR DEVELOPMENT. Finkelnburg, Wolfgang; Keller, Wolfgang. Siemens-Z., 39: 503-7(May 1965). (In German).

A description is given of the three inter-supplementary paths (reactor concepts) selected by Siemens-Schuckertwerke for the development of economic power reactors, and of the reasons which prompted this selection a heavy-water-cooled, natural-uranium pressure-vessel reactor, a CO_2-cooled, heavy-water-moderated pressure-tube reactor for high temperatures, and an enriched-uranium pressurized-water reactor with light water as the moderator and coolant. (auth)

43555 REFUELING AND REPAIRS OF THE PM-3A DURING THE 1964-65 AUSTRAL SUMMER. Beckett, Eugene F. (Atomic Energy Commission, New York). Trans. Am. Nucl. Soc., 8: Suppl., 3(1965).

43556 IN-VESSEL MODIFICATION OF IRRADIATED REACTOR INTERNALS AT BIG ROCK POINT. Hausler, L. M. (Consumers Power Co., Jackson, Mich.); Haueter, R. L.; Christianson, R. C. Trans. Am. Nucl. Soc., 8: Suppl., 3-5(1965).

43557 WORK PERFORMED ON FUEL CHANNELS AND THE CORE SUPPORT PLATE AT BIG ROCK POINT NUCLEAR POWER PLANT. Riesland, J. I.; Gustafson, E. A. (General Electric Co., San Jose, Calif.). Trans. Am. Nucl. Soc., 8: Suppl., 5-9(1965).

43558 RECENT PROBLEMS WITH EBR-II COMPONENTS. Whitham, G. K.; Leman, J. D. (Argonne National Lab., Ill.). Trans. Am. Nucl. Soc., 8: Suppl., 11-12(1965).

43559 SRE CORE REPLACEMENT. Woodruff, R. W. (Atomics International, Canoga Park, Calif.). Trans. Am. Nucl. Soc., 8: Suppl., 12(1965).

43560 DEMOLITION OF THE HEAT-TRANSFER SYSTEMS AT THE SODIUM REACTOR EXPERIMENT (IN PREPARATION FOR THE POWER EXPANSION PROGRAM). Nicholson, J. O. (Atomics International, Canoga Park, Calif.). Trans. Am. Nucl. Soc., 8: Suppl., 12-13(1965).

43561 PLANT SYSTEMS TRAINING OF PERSONNEL FOR EBR-II. Nelson, C. L.; Whitham, G. K.; Bryant, H.; Leman, J. D.; Greene, J. K. (Argonne National Lab., Idaho Falls, Idaho). Trans. Am. Nucl. Soc., 8: Suppl., 16(1965).

43562 OPERATING PROCEDURES FOR THE ML-1 (MOBILE LOW-POWER) NUCLEAR POWER PLANT. Sowards, Norman K. (Aerojet-General Nucleonics, Idaho Falls, Idaho). Trans. Am. Nucl. Soc., 8: Suppl., 20 (1965).

43563 CONTROL-ROD CALIBRATIONS FOR THE ENRICO FERMI REACTOR. Mueller, R. E.; Branyan, C. E.; Klickman, A. E. (Atomic Power Development Associates, Inc., Detroit). Trans. Am. Nucl. Soc., 8: Suppl., 21-2(1965).

43564 A TECHNIQUE FOR DETERMINATION OF THE SAFETY-ROD INSERTION TIME FOR THE ENRICO FERMI REACTOR. Horne, R. E.; Klockman, A. E. (Atomic Power Development Associates, Inc., Detroit). Trans. Am. Nucl. Soc., 8: Suppl., 22(1965).

43565 SENN WIRE-IRRADIATION SYSTEM USED TO EVALUATE POWER-DISTRIBUTION CALCULATIONS. Foreman, C. E. (General Electric Co., Pleasanton, Calif.). Trans. Am. Nucl. Soc., 8: Suppl., 23-4(1965).

43566 NEUTRON MEASUREMENTS IN HIGH GAMMA BACKGROUNDS. Bluestein, Irwin (Milletron, Inc., Irwin, Penna.). Trans. Am. Nucl. Soc., 8: Suppl., 24 (1965).

43567 ADDED SOURCE-RANGE DETECTORS FOR THE ENRICO FERMI ATOMIC POWER PLANT. Alexanderson, Eldon L.; Harrigan, Philip M. (Power Reactor Development Co., Detroit). Trans. Am. Nucl. Soc., 8: Suppl., 26-7(1965).

43568 MAJOR OPERATING AND REFUELING PROBLEMS AT THE YANKEE ATOMIC ELECTRIC COMPANY ROWE POWER PLANT. Reed, Glenn A. (Yankee Atomic Electric Co., Boston). Trans. Am. Nucl. Soc., 8: Suppl., 28(1965).

43569 OPERATING EXPERIENCE AT INDIAN POINT. Prestele, J. A. (Commonwealth Edison Co., Chicago). Trans. Am. Nucl. Soc., 8: Suppl., 30-1(1965).

43570 ELK RIVER REACTOR OPERATIONS. Campbell, Robert (Rural Cooperative Power Association, Elk River, Minn.); Signorelli, Joseph A. Trans. Am. Nucl. Soc., 8: Suppl., 31(1965).

43571 SOME ASPECTS OF OPERATING EXPERIENCE AT THE AGESTA NUCLEAR POWER PLANT. Rydell, Nils (Aktiebolaget Atomenergi, Stockholm). Trans. Am. Nucl. Soc., 8: Suppl., 31-2(1965).

43572 EVALUATION OF LONG-TERM OPERATION ON SRE SODIUM SYSTEMS. Keaten, R. W.; Mannas, D. A.; Olson, W. H. (Atomics International, Canoga Park, Calif.). Trans. Am. Nucl. Soc., 8: Suppl., 32-3(1965).

43573 MODERATOR ELEMENT FAILURES IN THE HALLAM NUCLEAR POWER FACILITY. Davidson, R. H. (Consumers Public Power District, Hallam, Neb.). Trans. Am. Nucl. Soc., 8: Suppl., 35(1965).

43574 FUEL-ELEMENT DEFECTS IN CERMET-TYPE FUELS IN THE SM-1 AND PM-3A REACTORS, AND CONSEQUENT PM-3A CONTAINMENT AIR ACTIVITY. Battist, L. (Nucléar Utility Services, Inc., Washington, D. C.); Smith, E. R.; Lowe, S. D.; DeLaPaz, A. Trans. Am. Nucl. Soc., 8: Suppl., 38(1965).

43575 FISSION-PRODUCT AND CARBON RETENTION IN SRE COLD TRAPS. Hansen, A. I.; Carter, T. J. (Atomics International, Canoga Park, Calif.). Trans. Am. Nucl. Soc., 8: Suppl., 38-9(1965).

43576 CONTAINMENT VESSEL INTEGRATED LEAK-TEST EXPERIENCE AT THE SAXTON NUCLEAR EXPERIMENTAL REACTOR. Erion, T. L. (Westinghouse Electric Corp., Madison, Pa.); Roth, J. M. Jr. Trans. Am. Nucl. Soc., 8: Suppl., 40(1965).

43577 EBR-II REACTOR BUILDING LEAK TESTING. Whitham, G. K.; Tebo, F. J.; McGinnis, F. D. (Argonne National Lab., Idaho Falls, Idaho). Trans. Am. Nucl. Soc., 8: Suppl., 40-1(1965).

43578 CVTR STARTUP PROBLEMS. McGrath, R. G. (Westinghouse Electric Corp., Madison, Penna.); Babb, H. T. Trans. Am. Nucl. Soc., 8: Suppl., 42-3(1965).

43579 ON THE THERMODYNAMICS OF NUCLEAR REACTORS. Bueki, Gergely (Technische Universitaet, Budapest). Wiss. Z. Tech. Univ. Dresden, 13: 1135-8 (1964). (In German).

A procedure for the thermodynamic evaluation of the heat produced in a reactor is developed. Expressions are developed for the electric and thermal power of a reactor, allowing the determination of reactor cooling efficiency as their quotient. It is then demonstrated that for cylindrical reactors, better utilization of the reactor may be achieved by introduction of the coolant in the middle of the cooling channels and by operation of individual cooling channels at different coolant temperatures. Axial temperature plots for this system and the usual cooling system are presented. Likewise, in a spherical reactor, the cooling system is improved by directing the coolant from the center radially to the exterior. The load dependence of the cooling parameter is discussed. Such parameters are based on thermodynamics, and such an approach seems fruitful. The maximum and economically optimum power output of a reactor may be calculated; and the utility of consideration of the mean coolant temperature, efficiency, and heat output as functions of the electric output is discussed. (BBB)

43580 COMPACT MOBILE NUCLEAR POWER PLANT. Wetch, Joseph R.; Dieckamp, Herman M.; Davis, Monte V. (to North American Aviation, Inc.). Canadian Patent 707,874. Apr. 13, 1965.

A mobile nuclear power plant using zirconium hydride moderator and boiling water coolant is described. The proposed reactor, with a 2000-kw output, has increased energy and power densities, reduced reactivity effect, and a low concentration of steam in the core. (F.S.A.)

Production Reactors

43581 INSPECTION OF CRITICAL PROCESS-TUBE COMPONENTS AT HANFORD. Bennett, Earl C. (General Electric Co., Richland, Wash.). Trans. Am. Nucl. Soc., 8: Suppl., 2-3(1965).

43582 EVALUATION OF THE HANFORD PERSONNEL CERTIFICATION PROGRAM. Nelson, Sterling L. (General Electric Co., Richland, Wash.). Trans. Am. Nucl. Soc., 8: Suppl., 14(1965).

43583 ON-LINE COMPUTER ASSISTS REACTOR OPERATION AT SAVANNAH RIVER PLANT. Gimmy, K. L.; Field, F. R. (E. I. duPont de Nemours and Co., Aiken, S. C.). Trans. Am. Nucl. Soc., 8: Suppl., 53-4 (1965).

43584 ANALOG COMPUTER SIMPLIFIES OPERATION OF SAVANNAH RIVER HIGH FLUX CHARGE. Occhipinti, E. S.; Mix, P. E.; Stutheit, J. S.; Field, F. R. (E. I. duPont de Nemours and Co., Aiken, S. C.). Trans. Am. Nucl. Soc., 8: Suppl., 54-5(1965).

43585 GADOLINIUM NITRATE INJECTION AS AN AUXILIARY SHUTDOWN SYSTEM FOR SAVANNAH RIVER REACTORS. Heinrich, L. A. (E. I. duPont de Nemours and Co., Aiken, S. C.). Trans. Am. Nucl. Soc., 8: Suppl., 56(1965).

Propulsion and Space

See also ENGINEERING — Space Propulsion.

43586 (HW-77029) N-REACTOR, PRESSURIZER-HIGH PRESSURE INJECTION PUMP SIMULATION STUDY.

PART III. SYSTEM RESPONSE DURING SCRAM. Robinson, R. K. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). May 17, 1963. Contract AT(45-1)-1350. 105p. Dep. mn; CFSTI $4.00 cy, $0.75 mn.

Analog simulations are carried out of the NPR pressurizer and high-pressure-injection system performance during scram operation. The simulations are typical of five-coolant-loop operation with an initial pressurizer pressure of 1300 psia. The calculations are carried out using EASE and GEDA analog computers. (T.F.H.)

43587 (TIM-880) MORTIMER—A NEUTRON SHIELDING CODE FOR SNAP SYSTEMS UTILIZING THE TWO-COMPONENT METHOD. Friedman, A. J. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). Jan. 7, 1965. Contract AT(30-1)-2789. 21p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

MORTIMER calculates the neutron flux at a dose point anywhere in a SNAP-50 geometry, by utilizing a two-component method in which the flux is composed of collimated and diffuse components. The code is used to calculate the shielding requirements and performance, and the masses of the grid region, coolant region, and shield for SNAP-50. (T.F.H.)

43588 (UCRL-14148-T) FUNDAMENTAL MATERIALS LIMITATIONS IN HEAT-EXCHANGER NUCLEAR ROCKETS. Kane, J. S.; Wells, W. M. Jr. (Lawrence Radiation Lab., Univ. of California, Livermore). May 24, 1965. Contract W-7405-eng-48. 26p. (CONF-650711-1). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

From AIAA 2nd Annual Meeting and Technical Demonstration, San Francisco.

Materials limitations are delineated for gas-heating propulsion reactors for the distant future. The method cannot deal with gaseous reactors, so in that sense they are excluded. Liquid reactors are permitted by the implicit assumption that their design is achievable. Once a gaseous species is formed, it is assumed lost from the reactor, thus reducing performance by lowering specific impulse. Chemical reactions leading to material losses are considered, as are means of minimizing losses caused by reactions with the hydrogen propellant. Pessimistic performance predictions based on thermodynamic equilibria are made. Where performance is limited by material loss, UC dissolved in more refractory carbides will give a high temperature capability, but one not greatly superior to simple binary solutions of uranium in refractory metals. A review of graphite Rover and BeO Pluto reactors reveals the most serious material limitation to be that associated with the reaction of the coolant and moderator, indicating good reason to remove the moderator from the core. A strong case is made for ignoring the supposed thermal stress problems of carbides. Thus, several indications point to carbides as the ultimate materials for heat-exchanger nuclear rockets, operating below the melting point in the immediate future, and perhaps far above the melting point in the distant future. (auth)

43589 A NITROGEN SUPPLY SYSTEM FOR POST-RUN COOLDOWN OF NUCLEAR REACTORS. Fretwell, J. H. (Los Alamos Scientific Lab., N. Mex.). Advan. Cryog. Eng., 10: 402-7(1965). (LADC-6414).

A system developed for the cooling of nuclear rocket engines upon completion of static testing is described. (D.C.W.)

43590 MARITIME REACTORS. Power Reactor Technol., 8: No. 1, 97-102(Winter 1964-65).

Descriptions are given of the nuclear power plants for the Russian icebreaker Lenin and the German vessel Otto Hahn, and of the Vulcain and Nero marine propulsion reactors. (T.F.H.)

43591 REACTORS FOR SPACE TRAVEL. Budnick, Dietrich; Oldekop, Werner. Siemens-Z., 39: 526-31 (May 1965). (In German).

Possible applications of reactors in space travel are discussed: nuclear-thermal propulsion and power supply. With nuclear propulsion, a very high power reactor (several thousand megawatts) is used to heat a propellant flowing through it (reactor operating time a few minutes). Power supply reactors produce electric energy in conjunction with energy convertors in a power range from a few kilowatts to a megawatt (operating periods a few months to years). A report is given on the advantages and disadvantages of such systems and on work in this field. (auth)

43592 SELECTION AND TRAINING OF THE TEST OPERATIONS STAFF FOR THE NERVA REACTOR DEVELOPMENT PROGRAM. Johnson, M. T. (Westinghouse Astronuclear Lab., Pittsburgh). Trans. Am. Nucl. Soc., 8: Suppl., 15(1965).

43593 CONTINUOUS OPERATION OF THE S8ER. Rooney, V. L. (Atomics International, Canoga Park, Calif.). Trans. Am. Nucl. Soc., 8: Suppl., 32(1965).

43594 AUTOMATIC STARTUP AND OPERATION OF SNAP-10A FLIGHT SYSTEM IN A SIMULATED SPACE ENVIRONMENT. Brinkman, D. S.; Pekrul, P. J. (Atomics International, Canoga Park, Calif.). Trans. Am. Nucl. Soc., 8: Suppl., 43-4(1965).

43595 TUG-TOW ARRANGEMENT FOR NUCLEAR AIRCRAFT. Bernstein, S. (to U. S. Atomic Energy Commission). U. S. Patent 3,208,692. Sept. 28, 1965.

An operationally-integrated combination of a nuclear powered tug aircraft coupled to and controlled from a distant tow aircraft is designed. The shielding requirements of the nuclear reactor in the tug aircraft are considerably reduced due to the distant position of the operating crew in the tow aircraft. (AEC)

Research and Test Reactors

43596 COMPARISONS BETWEEN TYPE BR-2 AND TYPE ETR OF MATERIAL TEST REACTORS. Nishimura, K. Meidensha Rev., No. 56, 39-43(Aug. 1964). (In Japanese).

The differences between the power reactor and the materials testing reactor are outlined, and the cores and structures of the BR-2 and the ETR are compared. It is concluded that the BR-2 is suitable for installation in the JAERI from the standpoint of nuclear safety, although there are some disadvantages in economy and life. (D.C.W.)

43597 THE REACTOR BR2, TOOL FOR PHYSICS RESEARCH. de Mevergnies, M. Neve (Centre d'Etude de Energie Nucleaire, Mol, Belgium). Rev. Questions Sci., 135: 375-90(July 1964). (In French).

The beryllium-moderated, water-cooled reactor BR-2, designed to provide a neutron flux of at least 5×10^{14} n/cm^2/sec, is described, together with the associated experimental facilities. Uses of the reactor are outlined with emphasis on applications to research in nuclear and solid-state physics. (D.C.W.)

43598 FUEL ELEMENTS FOR THE MULTI-PURPOSE RESEARCH REACTOR (MZFR). Schweickert, Hans; Stehle, Heinz. Siemens-Z., 39: 507-13(May 1965). (In German).

Following a brief description of the physical fundamentals, the design and technical considerations involved in the dimensioning of the MZFR fuel elements are treated. The data for testing of the individual components and for the manufacture of the fuel elements were obtained from laboratory and reactor tests. The concluding remarks on further development indicate clearly the trend towards a reduction in the costs of the fuel elements and thus to an improvement in the economic efficiency of the nuclear power station. (auth)

43599 THE ZERO-ENERGY EXPERIMENT FOR THE MULTI-PURPOSE RESEARCH REACTOR (MZFR). Behrens, Ernst; Gruen, Arnold E.; Ritz, Hilmar. Siemens-Z., 39: 513-17(May 1965). (In German).

The importance of the zero-energy experiments for the MZFR and the further development of this type of reactor is demonstrated. By way of typical examples, methods of measurement and evaluation are discussed, and comparisons are made with theoretical results. (auth)

43600 THERMAL-COLUMN PNEUMATIC FACILITY. de Sainte Maurice, Arthur; Canfield, Richard (Columbia Univ., Plainsboro, N. J.). Trans. Am. Nucl. Soc., 8: Suppl., 1(1965).

43601 ELIMINATION OF HYDRAULICALLY INDUCED CORE VIBRATIONS IN THE GENERAL ELECTRIC TEST REACTOR. Dalke, C. Arthur (General Electric Co., Pleasanton, Calif.). Trans. Am. Nucl. Soc., 8: Suppl., 2 (1965).

43602 IN-SITU REPAIRS WITHIN THE HWCTR PRESSURE VESSEL. Gray, P. L. (E. I. duPont de Nemours and Co., Aiken, S. C.). Trans. Am. Nucl. Soc., 8: Suppl., 9-11(1965).

43603 A THREE-YEAR EVALUATION OF MILD STEEL AT THE HEAVY WATER COMPONENTS TEST REACTOR. McKibben, J. Malvyn (E. I. duPont de Nemours and Co., Aiken, S. C.). Trans. Am. Nucl. Soc., 8: Suppl., 11(1965).

43604 AN EXPERIMENTAL EVALUATION OF ERRORS ARISING FROM THE BURNUP CALCULATION USED AT THE ORNL RESEARCH REACTOR. Hamrick, T. P. (Oak Ridge National Lab., Tenn.). Trans. Am. Nucl. Soc., 8: Suppl., 25-6(1965).

43605 ABSOLUTE POWER MEASUREMENTS OF THE FORD NUCLEAR REACTOR. Bullock, J. B. (Univ. of Michigan, Ann Arbor). Trans. Am. Nucl. Soc., 8: Suppl., 26(1965).

43606 MEASUREMENT AND CONTROL OF RADIATION-INDUCED GROWTH OF THE BROOKHAVEN GRAPHITE REACTOR. Singer, Robert M.; Thompson, Dudley (Brookhaven National Lab., Upton, N. Y.). Trans. Am. Nucl. Soc., 8: Suppl., 29(1965).

43607 SIX-YEARS OPERATING EXPERIENCE WITH PWR PLANT COMPONENTS. Heffner, R. E. (Phillips Petroleum Co., Idaho Falls, Idaho). Trans. Am. Nucl. Soc., 8: Suppl., 29-30(1965).

43608 DEFECTIVE FUEL TESTS IN THE NUCLEAR SUPERHEATING REACTOR BORAX-V. Cutforth, D. C.; Miles, C. C.; Villarreal, R. (Argonne National Lab., Idaho Falls, Idaho). Trans. Am. Nucl. Soc., 8: Suppl., 35-6 (1965).

43609 FUEL-PLATE MELTING AT THE OAK RIDGE RESEARCH REACTOR. Tabor, W. H. (Oak Ridge National Lab., Tenn.). Trans. Am. Nucl. Soc., 8: Suppl., 36-7(1965).

43610 TRANSPORT AND BUILDUP OF RADIOACTIVE MATERIALS IN REACTOR SYSTEMS AS DETERMINED BY SHUTDOWN RADIATION MEASUREMENTS. Perrigo, Lyle D. (Battelle-Northwest, Richland, Wash.). Trans. Am. Nucl. Soc., 8: Suppl., 37-8(1965).

43611 CONTAINMENT TESTING THE HIGH FLUX BEAM REACTOR. Reyer, R. J. (Brookhaven National Lab., Upton, N. Y.). Trans. Am. Nucl. Soc., 8: Suppl., 39-40(1965).

43612 PRE-NEUTRON TESTING AND STARTUP EXPERIENCE—THE ADVANCED TEST REACTOR. Keller, F. R. (Phillips Petroleum Co., Idaho Falls, Idaho). Trans. Am. Nucl. Soc., 8: Suppl., 42(1965).

43613 HFIR PRE-OPERATIONAL TEST PROGRAM. Dixon, G. J. (Oak Ridge National Lab., Tenn.). Trans. Am. Nucl. Soc., 8: Suppl., 44(1965).

43614 PRE-STARTUP HYDRAULIC TESTS AT THE AIR FORCE NUCLEAR ENGINEERING TEST FACILITY. Lewis, Valta G.; Buoni, Frederick B.; Hary, Laszlo B.; Vallish, Edward J. (Air Force Flight Dynamics Lab., Wright Paterson AFB, Ohio). Trans. Am. Nucl. Soc., 8: Suppl., 44-5(1965).

43615 INTENSIVE USE OF DIDO TYPE MTR'S. Panter, R. (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). Trans. Am. Nucl. Soc., 8: Suppl., 45-6(1965).

43616 OPERATING EXPERIENCE WITH A HEAVY-WATER-REFLECTOR TANK. Martin, Robert D. (Univ. of Michigan, Ann Arbor). Trans. Am. Nucl. Soc., 8: Suppl., 46(1965).

43617 CONTROL OF OXYGEN IN PRTR HELIUM SYSTEMS. Dulin, R. V. (Battelle-Northwest, Richland, Wash.). Trans. Am. Nucl. Soc., 8: Suppl., 46-7(1965).

43618 STABILITY OF U–$ZrH_{1.7}$ STAINLESS-CLAD TRIGA FUEL ELEMENTS SUBJECTED TO LARGE REACTIVITY INSERTIONS AND LONG-TERM STEADY-STATE OPERATION. Coffer, C. O.; Shoptaugh, J. R. Jr.; Whittemore, W. L. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Trans. Am. Nucl. Soc., 8: Suppl., 48(1965).

43619 PERFORMANCE OF HWCTR SAFETY SYSTEMS. Ross, C. P. (E. I. duPont de Nemours and Co., Aiken, S. C.). Trans. Am. Nucl. Soc., 8: Suppl., 50(1965).

43620 DESIGN, OPERATION AND UTILIZATION OF THE WHITE SANDS MISSILE RANGE FAST BURST REACTOR. Elder, Glenn E. (White Sands Missile Range Headquarters, N. Mex.). Trans. Am. Nucl. Soc., 8: Suppl., 50-1(1965).

43621 A GRAVITY INDEPENDENT REACTOR CONTROL SYSTEM. Pancoast, J. T. (General Dynamics, Fort Worth, Tex.). Trans. Am. Nucl. Soc., 8: Suppl., 51-3(1965).

43622 EXPERIENCE WITH ROD DROP TIMES AT THE UMRR. Edwards, D. R. (Univ. of Missouri, Rolla). Trans. Am. Nucl. Soc., 8: Suppl., 53(1965).

WASTE DISPOSAL AND PROCESSING

See also BIOLOGY AND MEDICINE — Ecology.
CHEMISTRY — Radiochemistry.
CHEMISTRY — Separation Processes and Procedures.
HEALTH AND SAFETY.

43623 (IDO-14653) FLUIDIZED BED CALCINATION OF SIMULATED ZIRCONIUM FLUORIDE WASTE IN EXPLORATORY PILOT PLANT TESTS. Petrie, J. C.; Bailey, E. J.; Rhodes, D. W.; Legler, B. M. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). July 1965. Contract AT(10-1)-205. 37p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

An exploratory pilot plant study of the fluidized bed calcination of zirconium fluoride waste with added calcium nitrate has shown that greater than 99 percent of the fluorides in the waste are retained in the calcined solids. Laboratory studies have indicated that mole ratios of calcium to fluoride considerably below the stoichiometric ratio were effective in suppressing fluoride volatilization. Corrosion tests conducted during the pilot plant study demonstrated that the austenitic stainless steels of which the Waste Calcining Facility is constructed will not be excessively corroded during calcination of zirconium fluoride waste in that facility. (auth)

43624 (RFP-534) AQUEOUS WASTE EVAPORATION. Butler, F. E.; Vance, J. N. (Rocky Flats Div., Dow Chemical Co., Denver, Colo.). Aug. 6, 1965. Contract AT(29-1)-1106. 23p. Dep. mn; CFSTI $2.00 cy, $0.50 mn.

A study of overall heat transfer coefficients in a short vertical tube evaporator for the concentration of salted aqueous wastes was conducted. The variables of solution concentrations, boiling temperature, temperature differential, and their effects on overall heat transfer coefficients were investigated. Decontamination factors were determined in relation to vapor velocities in the deentrainment section of the evaporator. (auth)

43625 WASTE SOLIDIFICATION PROTOTYPE PROGRAM. Platt, A. M.; Cooley, C. R. (Battelle-Northwest, Richland, Wash.). Atomics, 18: 22-5(July-Aug. 1965).

A spray solidification technique is described, which employs a spray calciner coupled to a continuous melter to convert high-level radioactive waste to a chemically inactive solid for storage. A pot calcination technique is described, in which a batch of liquid waste is added to a heated stainless steel pot until the waste becomes a thick sludge or salt cake. At this time the feed is stopped and heating continued until the waste is converted to a solid calcine at about 900°C. In the continuous phosphate glass process the liquid waste is mixed with phosphoric acid and concentrated to a thick slurry in an evaporator. The slurry is fed into a platinum melter where glass is formed. The molten glass flows into a receiver where it is solidified for storage. (M.C.G.)

43626 COMBINED BURIAL OF SOLID AND LIQUID RADIOACTIVE WASTES. Sobolev, I. A.; Khomchick, L. M. Gigiena i Sanit., No. 4, 79-80(Apr. 1965). (In Russian).

Previously liquid and solid wastes were buried separately in underground concrete vaults, but this system suffered from a number of obvious disadvantages such as leakage danger and improper utilization of space (50 to 55%) in solid storage. In order to improve the waste handling system a concrete mixer was installed above the underground concrete vault. The solid wastes were placed in the vault as usual. Then the liquid radioactive wastes containing 10^{-4} to 10^{-6} C/l was mixed with portland cement, and the cement solution was poured on top of the solid radioactive waste. The space utilization increased from 50% to 80%. Each vault has a volume of 50 to 100 m^3. The cost of storing the combined waste was decreased by one-half. (TTT)

43627 RADIOAKTIVNYE OTKHODY URANOVYKH ZAVODOV. (Radioactive Waste from Uranium Plants). Bakhurov, V. G.; Lutsenko, I. K.; Shashkina, N. N. Moscow, Atomizdat, 1965. 150p.

A brief review is given of uranium ore characteristics and uranium ore technology. Storage, purification, and waste disposal techniques during uranium ore processing are discussed. Methods for selective analysis of small amounts of radioactive elements are described. (R.V.J.)

GENERAL AND MISCELLANEOUS

43628 (BNL–8422) THE COLLECTION OF PORCINE PANCREATIC JUICE BY CANNULATION OF THE PANCREATIC DUCT. Wass, W. M. (Brookhaven National Lab., Upton, N. Y.). [Sept. 9, 1964]. Contract AT(30-2)-Gen-16. 14p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

A technique is described for the continuous collection of relatively large volumes of pure unactivated pancreatic juice from pigs. Continued total loss of the external pancreatic secretion by the pig results in death unless replacement therapy is instituted. The pig can be kept alive by supplementation of the ration with NaCl or $HaHCO_3$ but remains unthrifty. Best results are obtained if a portion of the secreted pancreatic juice is returned to the pig each day in the ration. (auth)

43629 (BNL–8423) THE COLLECTION OF BOVINE PANCREATIC JUICE BY CANNULATION OF THE PANCREATIC DUCT. Wass, W. M. (Brookhaven National Lab., Upton, N. Y.). [1960]. Contract AT(30-2)-Gen-16. 10p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

The collection of pancreatic juice from the bovine by simple cannulation of the pancreatic duct is described. The method yields large volumes of pure pancreatic juice suitable for purposes of enzymology. Unlike the canine and porcine species, the bovine tolerates the continuous loss of large volumes of pancreatic juice without apparent ill effects. (auth)

43630 (IS-T-17) INFRARED ABSORPTION IN MAGNESIUM GERMANIDE (thesis). Lott, Layman Austin (Ames Lab., Iowa State Univ. of Science and Tech.). May 1965. Contract W-7405-eng-82. 84p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Infrared absorption measurements on n- and p-type Mg_2Ge single crystals were made at wavelengths between 1.5 and 25 μ at temperatures between 4.2 and 300°K. The wavelength and temperature dependence of the absorption edge in p-type crystals is best fit by the theory of indirect electronic transitions from the valence band to the conduction band accompanied by the absorption and emission of phonons. A value of 0.570 ev for the energy gap at absolute zero and an average energy of 0.025 ev for the phonon involved in the indirect transition process were determined from the absorption edge measurements. The absorption edge of n-type crystals is masked by an absorption band near the edge, of which transitions involving sub-bands of the conduction band are the most likely source. At wavelengths longer than that of the absorption edge, the absorption coefficient of p-type crystals is dominated by absorption bands interpreted as being due to transitions between three germanium-like valence bands. The features of this spectrum are best explained by assuming a spin-orbit splitting of 0.20 ev and a ratio of heavy-hole to light-hole mass of 6 ± 1. The long wavelength absorption in n-type material has a $\lambda^{2.5}$ wavelength dependence which is that predicted by the theory of optical mode scattering. (auth)

43631 (LA-DC-6995) ELECTRICAL TRANSDUCER STUDIES OF INITIATION OF LIQUID EXPLOSIVES. Travis, J. R. (Los Alamos Scientific Lab., Univ. of California, N. Mex.). [1965]. Contract W-7405-eng-36. 18p. (CONF-651003-4). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From 4th Symposium on Detonation, Silver Spring, Md.

Electrical signals are generated by initial processes occurring in dielectric liquid explosives. A transducer utilizing this effect was developed. Comparison of the results obtained with the transducer and with a smear camera shows that the transducer can measure the time of events occurring during the initiation process with high precision. The transducer technique is particularly useful in the study of those explosives in which, because of their low luminosity, the entire initiation process cannot be observed with a smear camera. Differences in the initiation behavior of nitromethane, solutions of TNT in nitromethane, molten DINA, and molten TNT are described. (auth)

43632 (LA-DC-7135) STUDIES ON THE CELLULAR BIOCHEMISTRY AND ORGAN MASS OF COLD- AND HEAT-ACCLIMATED MONKEYS. Chaffee, R. R. J.; Horvath, S. M.; Smith, R. E.; Welsh, R. S. (Los Alamos Scientific Lab., Univ. of California, N. Mex.; California Univ., Santa Barbara. Environmental Stress Inst.; California Univ., Los Angeles. Center for the Health Sciences). [1964]. Contract W-7405-eng-36. 28p. (CONF-650921-1). Dep. mn; CFSTI $2.00 cy, $0.50 mn.

From Federation of American Societies for Experimental Biology, Symposium on Environmental Physiology, Kyoto.

To compare the effects of temperature acclimation on cellular metabolic changes in primates with those known to occur in rodents, a similar set of oxidative enzymatic assays done earlier on tissues of acclimated rodents was done on heat- and cold-exposed monkeys. Also, tissue levels of RNA, DNA, and protein/g of monkey tissue were measured, and body and organ weights, hematocrits, and gastrocnemius myoglobin levels were determined. Healthy adult male squirrel monkeys were used. Three groups of 30 each were exposed to 38, 24, and 14 C for 6 weeks. Oxidative enzyme levels of heart, kidney, liver, skeletal muscle, brown fat, cerebral hemispheres, hypothalamus, and cerebellum homogenates and of liver and kidney mitochondria and microsomes were measured. Very few of the many enzymatic systems assayed changed, and thus the cellular enzymatic responses of these monkeys are unlike those of rodents. Shifts in organ weights in cold- and heat-acclimated primates were generally similar to changes observed in cold- and heat-acclimated rodents. Neither hematocrit values nor muscle myoglobin levels changed. The total amounts of RNA in the kidneys, heart, and pancreas increased with cold, and in the pancreas there was even an increase in RNA/g protein. There was also an increase in total DNA and total protein but no change in total RNA in the liver. Heat acclimation resulted in a lower total protein in the liver and pancreas with no alterations in the heart or kidney protein levels. None of these organs exhibited a decrease in RNA/g. However, a decrease in total RNA proportional to the decrease in protein content was seen in the liver and pancreas, whereas no change in total protein or total RNA occurred in the heart or kidneys. There were no changes in cerebral RNA/g protein subsequent to either heat- or cold-acclimation. (auth)

43633 (NP-15354) PROGRESS REPORT [ON ELECTRONICS], MARCH, APRIL, MAY 1965. (Illinois Univ., Urbana. Coordinated Science Lab.). July 26, 1965. Contract DA-28-043-AMC-00073(E). 111p.

Investigations are reported in: geomagnetic and geophysical measurements in aerospace region; secondary electrons from scattering of 10- to 20-ev electrons by W single crystals; electronics for control systems; the development of PLATO teaching computer; development of a medium-resolution, high-sensitivity mass spectrometer; performance of a vacuum system of a particular design; instrumentation for analyzing incoherent scattering in plasma; the possibility of type II superconductivity in Re; electric field emission by sharp W points; flicker effects in field-emission microscopy; theory of electronic switching systems; and a theory of communications systems as weighted oriented linear graphs. A bibliography of 13 references to material on the electronic structure of Sn oxide films is included. (T.F.H.)

43634 (NYO-3481-6) INFLUENCE OF PROSTHETIC MATERIALS ON THE MINERAL LEVEL OF ORAL TIS-

SUES. Soeremark, Rune (Harvard School of Dental Medicine, Boston, Mass.). May 1965. Contract AT(30-1)-3481. 9p. (CONF-650543-1). Dep. mn; CFSTI $1.00 cy, $0.50 mn.

From Store KRO Club Conference, Falsterbo, Sweden.

Neutron activation in combination with γ spectroscopy was used to determine the normal content of certain trace elements in oral tissues. Data are presented on the content of 18 elements, including Ca and Sr, in normal enamel and dentin of teeth. The effects of materials used as prosthetic restorative materials on the content of their constituent elements in the hard and soft tissues of the oral cavity were investigated in dogs with various types of Au alloys used as inlays in the teeth for 15 days, after which the teeth were extracted and the teeth and adjacent gingiva were analyzed for Au and other minerals. Higher concentrations of Au, Cu, and Zn were found in these teeth and adjacent gingiva than in control teeth and gingiva from the same dog. Similar results were observed when Au clasps were attached to human teeth for about 3 weeks before they were extracted for orthodontic reasons. An analysis of a few teeth with partial Au crowns in situ for about 3 yr showed Au content of about 6 ppm in enamel and 15 ppm in dentin. This is about 100,000 times the Au content found in teeth without restorations. (C. H.)

43635 (SC-DC-65-1381) NITEHAWK 9. Womack, W. C. (Sandia Corp., Albuquerque, N. Mex.). Apr. 1965. Contract AT(29-1)-789. 59p. (CONF-650538-1). Dep. mn; CFSTI $3.00 cy, $0.75 mn.

From Annual General Meeting of the Canadian Aeronautics and Space Inst., Vancouver, B. C.

A detailed description is given of the Nitehawk 9, a data gathering rocket system that was designed to be a general workhorse in the fields of sounding rockets and space physics studies. The appendices discuss: motor information, attitude reference system, description of extra-atmospheric coning, recovery system, theoretical trajectory, and flight data sheets. (M.O.W.)

43636 (SC-TM-65-217) PREDICTED SHOCK WAVE PATTERNS FOR A SUPERSONIC CONICAL MISSILE PASSING THROUGH A BLAST WAVE. Zumwalt, G. W.; Damkevala, R. J. (Oklahoma State Univ., Stillwater). May 1965. Contract AT(29-1)-789. 10p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

For Sandia Corp., Albuquerque, N. Mex.

Three possible shock-wave interaction patterns are discussed, and an analysis is made by assuming perfect gas relations. (auth)

43637 (TID-21171) JOULE LOSS IN A PERFECT CONDUCTOR IN A MAGNETIC FIELD. Report No. 201. Goodman, J. M.; Legendy, C. R. (Cornell Univ., Ithaca, N. Y. Materials Science Center). May 1, 1964. Contract AT(30-1)-2179. 24p. Dep. mn; CFSTI $1.00 cy, $0.50 mn.

Calculations of the skin effect in the presence of a magnetic field exhibiting some novel features in the dependence of the power absorption on frequency and conductivity are presented. In particular, in the limit of classical "perfect" conductivity (in which $\sigma \to \infty$ but the effects of finite electron mean free path and scattering time are neglected) the loss tends to a nonzero limit independent of the conductivity and is confined to the surface. For available fields and sample conductivities, this limiting case is a good approximation at low frequencies and is relevant to many studies of helicons in metals. Data from a preliminary experiment on sodium at 4.2°K in a 55 kG magnetic field for frequencies below a few kilocycles are presented and analyzed. (auth)

43638 (TID-22130) PROGRESS REPORT [ON PRESERVATION OF HUMAN PLATELETS], 1964-1965. (Children's Cancer Research Foundation, Boston, Mass.). Contract AT(30-1)-1753. 63p. Dep. mn; CFSTI $3.00 cy, $0.75 mn.

Studies on preservation of human platelets were continued. An improved container for freezing concentrates was designed, manufactured, and found suitable for semi-routine use of frozen platelet concentrates. Using this container, consistent in vivo recovery of frozen platelets comparable to 50% of that of fresh platelets was observed. The painful venospasm occasionally associated with infusion of frozen platelets was reduced or completely eliminated by dilution of the preserved concentrates with fresh plasma just prior to injection. Transfusions of fresh platelets were studied in adults and in children treated with chemotherapy beyond the limitation imposed by thrombocytopenia. The theoretical usefulness of platelet transfusions for protecting individuals exposed to massive and otherwise hazardous doses of chemical agents (or x-radiations with similar effects) is being documented by actual experience. Transfusions of normal concentrated white blood cells were demonstrated to be clinically possible and potentially helpful. Preservation of white blood cells is essential for further routine transfusions of leukocytes. Therefore, a preparation of frozen granulocytes capable of phagocytosis in vitro after thawing was developed. An animal experimental model for in vivo studies of preserved human leukocytes was devised. Evaluation of the ability of frozen human leukocytes to circulate in vivo was thus initiated. A platelet extract previously shown by this group to reduce vascular fragility was found to contain at least two platelet antigens related to the thrombocytopenic and hemorrhagic effects repectively of heterologous platelets antibodies. Efforts for separation and studies of these materials in relation to their effects on vascular properties are in progress. (auth)

43639 (UCRL-16207) SPECTROSCOPIC STUDIES OF PHOTOSYNTHESIS (thesis). Kuntz, Irwin Douglas Jr. (Lawrence Radiation Lab., Univ. of California, Berkeley). June 1965. Contract W-7405-eng-48. 253p. Dep. mn; CFSTI $6.00 cy, $1.25 mn.

Sensitive measurements of the visible absorption spectra of photosynthetic materials have revealed that upon illumination conducive to photosynthetic activity the concentrations of various endogenous compounds are reversibly altered. Such measurements require sophisticated averaging techniques to achieve the necessary noise levels of less than 10^{-5} O.D. units and the time resolution of less than 1 millisecond. Suitable instrumentation is described in detail. A major consideration was the identification of the photo-reactive species on the basis of their absorption spectra. A summary of the available data on the various compounds thought to be involved is presented, and from this evidence it is concluded that chlorophylls, cytochromes, flavins, quinones, carotenoids, and pyridine nucleotides are involved in algal and bacterial photosynthesis. The types of reactions which these molecules might undergo are also discussed. A measurement of the redox properties of bacterial chromatophores indicated that there are two essential pigments involved; one has a midpoint potential of +0.44 volt and evidence is offered that this pigment is bacteriochlorophyll; the other has a midpoint potential of −0.04 volt. Some of the intermediates found in the bacterial systems showed different decay kinetics from compound to compound. On such a kinetic basis it was possible to relate the photoproduced absorption band at 433 mμ to the photoproduced electron paramagnetic resonance signal. Kinetic studies in algae indicated by indirect means that a close correspondence exists between the overall electron flow behavior involved in oxygen evolution and the initial decay rates of the photoproduced intermediates. The restrictions that such observations place on photosynthetic mechanisms are discussed. A semi-quantitative mathematical analysis of electron flow systems is presented. Relationships between the mathematical models and the experimental observables are emphasized. Analog computer techniques are briefly considered. (139 references.) (auth)

43640 (JPRS-31473) TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 203. Translation of K'o Hsueh T'ung Pao, No. 12, 1037-63; 69-80; 1092-9; 1100-29(Dec. 17, 1964). 163p. (TT-65-31969). CFSTI $5.00 cy, $1.00 mn.

For an abstract of the individual paper see: 42527.

43641 CONCEPTS OF THE TRUE POSITION DIMENSIONING SYSTEM. A Programmed Textbook. Utter, R. F.;

Bridegam, A. D.; Dell, R. O.; Dunlap, R. E.; Fisher, D. R.; Taylor, J. E. (Sandia Corp., Albuquerque, N. Mex). 1965. Contract AT(29-1)-789. 182p. Central Scientific Co., Chicago, Ill.; $7.95 cy.

A system of engineering-drafting practices is described whose purpose is the clarification and simplification of dimensioning techniques in engineering drawings. The text is a basic manual in the use of the system. (T.F.H.)

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Because of problems involving the mechanical preparation of this index, all accent marks are omitted. The following changes in spelling have been introduced to reduce some of the confusion which might result from omitting the accents:

ä	becomes	ae
ö		oe
ø		oe
ü		ue (except in transliterated Chinese names)

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SUBJECT INDEX

Main entries in this index are generally specific materials, things, and processes. These are followed by modifiers that describe the properties of, and processes applied to, the main entries.

The number preceding the colon is the *NSA* volume number, and the number following is the abstract number. The designation (R) following the abstract number indicates that the abstract is of a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. References to report numbers, where appropriate, are included after the abstract number of the citation. Published literature (journal article or book) is identifiable by the absence of a report number.

The user should bear in mind that the ideas presented in the original literature, rather than key words, have been indexed. The indexers have tried to select what seemed the most probable and logical place to look for typical information. Since it is not possible to anticipate where a user would look for information, numerous cross references are included to assist him in his search.

Experience in using an index of this type will be the best guide in obtaining the desired information, and a consideration of synonymous or closely related terms will prove valuable.

Information must be so indexed as to be of the greatest use to the greatest number of users. This requires that a topic be indexed to headings that most specifically describe it and not ordinarily to the headings that describe its ultimate use, nor to the general class headings that include the specific headings. For example, information on the treatment of thyroid disease with I-131 would be indexed under Thyroid Diseases and under Iodine Isotopes I-131, but not necessarily under Radiotherapy. A study of the effects of x radiation on hair would be indexed under both X Radiation and Hair.

The broad, general class headings are used only for general information or for comprehensive reports or articles.

Subject Heading Styles

Generally, the direct form of subject entry is used rather than inverted headings or, in some cases, subheadings; e.g., Amino Acids rather than Acids, amino; Helium Isotopes He-4 rather than Helium — isotopes He-4 or Helium — He-4 isotopes. Note, however, that in some cases modifying terms are used parenthetically in preference to a more direct type of entry which would result in the scattering of information. Organic compounds, however, are usually entered in the index in the inverted form so that substituted compounds can be listed near the parent compound; e.g., Benzene, Bromo- rather than Bromobenzene. In general, the style of nomenclature used is that of *Chemical Abstracts*, except that some items listed in that publication as subheadings are elevated to form part of the main heading; e.g., Butyric Acid, Methyl Ester rather than Butyric Acid — methyl ester.

Alphabetization

Main headings are arranged according to the widely accepted word-by-word alphabetic system. A parenthetic qualifier following a main heading is disregarded in alphabetizing unless there are two or more headings identical except for the parenthetic qualifier, in which case the qualifier determines the order. Headings involving Greek letters are arranged as if the names of the letters were spelled out, e.g., Mesons (π), Mesons (ζ).

Nomenclature of Inorganic Compounds

Inorganic compounds are indexed in the direct form, listing cations in the order of increasing valence in the case of polycationic salts of varying valence and in alphabetic order for polycationic salts in which all cations have the same valence; e.g., Sodium Aluminum Silicates and Potassium Sodium Sulfates.

Multicomponent Systems

Multicomponent alloys, except well-known trade names, are indexed under each element in the alloy.

Example: Aluminum–Chromium Alloys are indexed

ALUMINUM ALLOYS
Al–Cr ...
CHROMIUM ALLOYS
Al–Cr ...

Well-known alloys such as Hastelloy are indexed directly. Cross references appear in the index cumulations. Multicomponent systems of elements are indexed similarly.

Example: Silicon–Tungsten Systems are indexed

SILICON SYSTEMS
Si–W ...
TUNGSTEN SYSTEMS
Si–W ...

Multicomponent systems of compounds are similarly indexed under the compound.

Physical States of Materials

Specification of the physical state of the material, if other than normal, is included in the modifying phrase.

Modifying Phrases (Subheadings)

Whenever it appears that such information would be useful, descriptive phrases (modifiers), rather than ordinary subheadings, are used under the main headings to give a better indication of the material covered in an abstract. Such phrases are written so that the idea considered most important is presented first. However, when using this index, the reader is advised to scan all modifiers under a main heading to determine whether any abstracts in addition to the most obvious should be consulted for the desired information. Many of the modifiers are designed to be read in inverted order or to be read with the main heading inserted at the position of the comma in order to obtain a meaningful phrase; e.g., Uranium–allotropic transformation temperatures of, effect of cooling rate on is read "effect of cooling rate on allotropic transformation temperatures of uranium." In many cases, the prepositions have been

omitted from such phrases provided no ambiguity results from the omission.

For entries concerned with physics, if the modifier does not indicate whether the reference is experimental or theoretical, a symbol E or T or E/T is given.

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AERE-R–	**(British)**	
4866	19-42707	Dep.; BIS, $0.90; HMSO, 4s. 6d.
4873	19-42839	Dep.
4888	19-42592	Dep.; BIS, $0.70; HMSO, 3s. 6d.
4933	19-42616	Dep.; BIS, $0.70; HMSO, 3s. 6d.
4934	19-43467	
4949	19-42708	Dep.; BIS, $0.60; HMSO, 3s.
4961	19-42709	Dep.; BIS, $0.30; HMSO, 1s. 9d.
AERE-Trans–	**(British)**	
1027	19-42855	Dep.; JCL, $2.60 fs, $1.01 mf
AFCRL–	**(Non-AEC)**	
63-641	19-43216	See AD-425787
64-433	19-43018	See AD-609216
AGN–	**(Misc.)**	
8137(Vol.II)	19-42525	Dep. mn; CFSTI, $6.00 cy, $1.25 mn
AID-T–	**(Non-AEC)**	
63-124	19-43052	See AD-426473
AN–	**(Misc.)**	
1238	19-43402	See AD-609728
ANL–		
6960	19-42840	Dep. mn; CFSTI, $1.00 cy, $0.50 mn
ANL-Trans–		
209	19-42232	Dep. mn; CFSTI, $1.00 cy, $0.50 mn; JCL, $1.60 fs, $0.80 mf
APL-TDR–	**(Misc.)**	
64-97	19-43402	See AD-609728

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ARL–	**(Non-AEC)**	
65-95	19-43403	CFSTI
65-120	19-43404	
ASE–	**(Non-AEC)**	
426	19-43017	See AD-601274
509	19-43018	See AD-609216
AWRE-O–	**(British)**	
37/65	19-42409	Dep. mn; BIS, $0.60; HMSO, 3s.
BIO–	**(Italian)**	
32/63	19-42637	Dep. mn
BM-RI–	**(Misc.)**	
6649	19-42454	Bureau of Mines(Free)
BMI–	**(Misc.)**	
1721(Del.)	19-42801	Dep. mn; CFSTI, $1.00 cy, $0.50 mn
1739	19-42900	CFSTI, $0.75 cy, $0.50 mn
BMI-X–		
10133	19-43501	Dep. mn; CFSTI, $1.00 cy, $0.50 mn
BNL–		
8422	19-43628	Dep. mn; CFSTI, $1.00 cy, $0.50 mn
8423	19-43629	Dep. mn; CFSTI, $1.00 cy, $0.50 mn
8680	19-42301	Radiation Res., 25: 646-54(1965)
8681	19-42304	Radiation Res., 25: 684-94(1965)
8753	19-42548	Nucl. Appl., 1: 322-6(1965)
8829	19-42528	A.I.Ch.E. (Am. Inst. Chem. Engrs.) J., 11: 873-85(1965)
9224	19-43357	Phys. Rev., 140: B212-16(1965)
9364	19-43037	Dep. mn; CFSTI, $2.00 cy, $0.50 mn
9420	19-42959	Dep. mn; CFSTI, $1.00 cy, $0.50 mn
BNL-tr–		
7	19-43419	Dep. mn; JCL, $1.10 fs, $0.80 mf
BNWL–		
77	19-42924	Dep. mn; CFSTI, $2.00 cy, $0.50 mn
81	19-42405	Dep. mn; CFSTI, $1.00 cy, $0.50 mn
90	19-42654	Dep. mn; CFSTI, $6.00 cy, $1.25 mn
BNWL-SA–		
51	19-42410	Dep. mn; CFSTI, $2.00 cy, $0.50 mn
151	19-42901	Dep. mn; CFSTI, $1.00 cy, $0.50 mn
184	19-43521	Nucl. Sci. Eng., 23: 150-8(1965)
273	19-42593	Dep. mn; CFSTI, $1.00 cy, $0.50 mn
CALT–		
68-39	19-43131	Phys. Rev., 140: B85-9(1965)
CEA-Bib–	**(French)**	
56	19-42793	Dep. mn
CEA-R–	**(French)**	
2708	19-42241	Dep. mn
2757	19-42411	Dep. mn
2763	19-42841	Dep. mn
2767	19-42802	Dep. mn
CEA-tr–	**(French)**	
A-1750	19-42722	Dep. mn; JCL, $1.10 fs, $0.80 mf
CERN–	**(European Organization for Nuclear Research)**	
65-27	19-43038	Dep. mn
CEX–		
62.11	19-42655	Dep. mn; CFSTI, $1.25 cy, $0.75 mn
CONF-204–	**19-43487**	**(International Conference on Lattice Dynamics, Copenhagen, Denmark, Aug. 1963)**
CONF-554–	**19-42611** **19-42612**	**(Cryogenic Engineering Conference, Philadelphia, Aug. 1964)**
CONF-657–	**19-43030**	**(4th Annual Photovoltaic Specialists Conference, Cleveland, June 1964)**

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		See PIC-SOL-209/5.1(Vol.II)
CONF-758–		(American Physical Society Meeting, New York, Jan. 22–25, 1965)
56	19-43248	Gmelin, AED-CONF-65-003-117
CONF-773(Vol.II)–	19-42564	(Symposium on Chemical Effects Associated with Nuclear Reactions and Radioactive Transformation, Vienna, Dec. 1964) See STI-PUB-91(Vol.II)
CONF-804(Vol.I)–	19-43262	(Symposium on the Inelastic Scattering of Neutrons, Bombay, Dec. 15–19, 1964) See STI-PUB-92(Vol.I)
CONF-621103–	19-42888	(2nd All-Union Conference on Problems of Rhenium, Moscow, Nov. 19–21, 1962)
CONF-641017–		(Symposium on Low Energy X and Gamma Sources and Applications, Chicago, Oct. 20–21, 1964)
10	19-42377	See NYO-3481-1
11	19-42775	Gmelin, AED-CONF-64-221-14
CONF-641122–		(2nd Benedum Symposium on Earth Magnetism, Philadelphia, Nov. 23–25, 1964)
1	19-42988	Gmelin, AED-CONF-64-275-1
CONF-641218–		(American Geophysical Union, 4th Western Regional Meeting, Seattle, Dec. 28–30, 1964)
1	19-43026	Gmelin, AED-CONF-64-271-11
CONF-650220–		(American Physical Society, Southwest Meeting, Norman, Okla., Feb. 25–27, 1965)
3	19-42897	Gmelin, AED-CONF-65-002-1
CONF-650306–	19-37263	(Particle Accelerator Conference, Mar. 10–12, 1965, Washington, D. C.)
60	19-42965	See PPAD-2137-547
CONF-650405–		(International Conference on Modern Trends in Activation Analysis, College Station, Tex., Apr. 19–22, 1965)
19	19-42451	Gmelin, AED-CONF-65-040-27
CONF-650422–		(American Geophysical Union, Program for Section of Seismology Annual Meeting, Washington, D. C., Apr. 19–22, 1965)
6	19-43027	Gmelin, AED-CONF-65-118-22
10	19-43229	Gmelin, AED-CONF-65-118-31
11	19-43230	Gmelin, AED-CONF-65-118-32
CONF-650439–		(Conference on Radiation Sterilization of Medical Supplies and Pharmaceuticals, Stockholm, Apr. 27, 1965)
1	19-42776	See AECL-2264
CONF-650440–		(American Mathematical Society, 622nd Meeting, New York, Apr. 12–15, 1965)
3	19-43458	Gmelin, AED-CONF-65-095-3
CONF-650444–		(Western States Combustion Inst., 1965 Spring Meeting, Hollywood, Calif., Apr. 21–22, 1965)
2	19-42518	Gmelin, AED-CONF-65-119-3
3	19-42815	Gmelin, AED-CONF-65-119-2
CONF-650510–		(Purdue Conference on Instrumentation for High Energy Physics, Lafayette, Indiana, May 11–15, 1965)
13	19-42721	See UCRL-16286
CONF-650512–	19-37944	(Symposium on Engineering Problems of Controlled Thermonuclear Research, Livermore, Calif., May 4–7, 1965)
1	19-43405	See GA-6441
7	19-43415	See MATT-347
CONF-650513–		(American Ceramic Society, Annual Meeting, Philadelphia, May 4, 1965)
6	19-42898	Gmelin, AED-CONF-65-092-7
7	19-42896	Gmelin, AED-CONF-65-092-8
CONF-650519–		(13th Annual Conference of American Society of Testing Materials, St. Louis, May 16–21, 1965)
2	19-42461	See SC-R-65-956
4	19-43016	Gmelin, AED-CONF-65-120-19
CONF-650538–		(Annual General Meeting of the Canadian Aeronautics and Space Inst., Vancouver, B. C., May 17, 1965)
1	19-43635	See SC-DC-65-1381
CONF-650543–		(Stora KRO Club Conference, Falsterbo, Sweden, May 1965)
1	19-43634	See NYO-3481-6
CONF-650546–		(American Society of Mechanical Engineers, Design Engineering Conference and Show, New York, May 17–20, 1965)
1	19-42833	ORINS
CONF-650549–		(International Atomic Energy Agency, Symposium on Exchange Reactions, Upton, N. Y., May 31–June 4, 1965)
8	19-42517	ORINS
CONF-650559–		(American Institute of Chemical Engineers, 56th National Meeting, San Francisco, Calif., May 16–19, 1965)
3	19-42957	Gmelin, AED-CONF-65-086-10
5	19-42958	Gmelin, AED-CONF-65-086-22
CONF-650602–		(American Nuclear Society 11th Annual Meeting, Gatlinburg, Tenn., June 20–24, 1965)
56	19-43268	Gmelin, AED-CONF-65-125-62
57	19-43032	Gmelin, AED-CONF-65-125-71
58	19-42450	Gmelin, AED-CONF-65-125-3
CONF-650616–		(Health Physics Society, Annual Meeting, Los Angeles, June 14–17, 1965)
7	19-42410	See BNWL-SA-51
CONF-650642–	19-43536	(Symposium on Performance of Commercial Nuclear Power Stations in the U. K., Leicester, England, June 30, 1965)
CONF-650704–		(IAEA Symposium on Thermodynamics, Vienna, July 22–27, 1965)
26	19-42519	ORINS
CONF-650707–		(IEEE Annual Conference on Nuclear and Space Radiation Effects, Ann Arbor, Mich., July 12–15, 1965)
3	19-42771	See SC-R-65-941
CONF-650710–	19-43507	(American Nuclear Society, Meeting on Reactor Operating Experience, Jackson Lake Lodge, Wyo., July 28–30, 1965)
CONF-650711–		(AIAA 2nd Annual Meeting and Technical Demonstration, San Francisco, July 26–29, 1965)
1	19-43588	See UCRL-14148-T
45	19-42818	ORINS
46	19-42895	ORINS
47	19-43456	ORINS
CONF-650803–		(IAEA Symposium on Nuclear Materials Management, Vienna, Aug. 30–Sept. 3, 1965)
7	19-42412	See GAT-T-1224
CONF-650804–		(5th Rare Earth Research Conference, Ames, Iowa, Aug. 30–Sept. 1, 1965)
6	19-42842	Dep. mn; CFSTI, $1.00 cy, $0.50 mn
CONF-650813–		(6th Biennial Gas Dynamics Symposium, Evanston, Ill., Aug. 27, 1965)
1	19-43457	ORINS
CONF-650907–		(11th International Congress of Radiology, Rome, Sept. 24, 1965)
2	19-42966	See UCRL-16267
CONF-650921–		(Federation of American Societies for Experimental Biology, Symposium on Environmental Physiology, Kyoto, Japan, Sept. 13–17, 1965)

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1	19-43632	See LA-DC-7135
CONF-651003–	**(4th Symposium on Detonation, Silver Spring, Md., Oct. 13–15, 1965)**	
4	19-43631	See LA-DC-6995
COO–		
264-255	19-43144	Phys. Rev., 140: B178-82(1965)
264-256	19-43133	Phys. Rev., 140: B95-6(1965)
264-266	19-43104	Nuovo Cimento (10), 39: 377-80(1965)
359-10	19-42843	Dep. nn; CFSTI, $2.00 cy, $0.50 mn
427-46	19-42998	Phys. Rev., 140: A1-7(1965)
917-15	19-43250	Dep. nn; CFSTI $5.00 cy, $1.00 mn
1080-1	19-42257	Dep. nn; CFSTI, $2.00 cy, $0.50 mn
1170-6	19-42242	Dep. nn; CFSTI, $2.00 cy, $0.50 mn
1195-34	19-43039	Dep. nn; CFSTI $3.00 cy, $0.75 mn
1198-283	19-42844	Dep. nn; CFSTI, $3.00 cy, $0.75 mn
1256-2	19-42230	Dep. nn; CFSTI, $1.00 cy, $0.50 mn
1261-9	19-43136	Phys. Rev., 140: B124-6(1965)
1477-1	19-42845	Dep. nn; CFSTI, $1.00 cy, $0.50 mn
CU–	**(Misc.)**	
1932-244	19-43040	Dep. nn; CFSTI, $1.00 cy, $0.50 mn
DESY–	**(German)**	
65/4	19-42960	Dep. nn
DF–	**(Misc.)**	
65SL-205	19-42819	
DL–	**(Canadian)**	
67	19-43504	Can. Nucl. Technol., 4: 46-50(1965)
DOCKET–	**(Non-AEC)**	
50-201	19-42599	See NP-15312
50-201	19-42598	See NP-15311(Vol.II)(Pt.B)
50-201	19-42597	See NP-15311(Vol.I)(Pt.B)
DP–		
344	19-42594	Dep. nn; CFSTI $2.00 cy, $0.50 mn
984	19-42789	Dep. nn; CFSTI $1.00 cy, $0.50 mn
DUBNA REPORTS	**(Russian)**	
See JINR (Russian)		
ECOM–	**(Non-AEC)**	
2516	19-42678	See AD-609658
ER–	**(Misc.)**	
15	19-43418	See NP-15357
1399-6	19-42800	See AD-617733
EUR–	**(European Atomic Energy Community)**	
405.f	19-42577	Dep. nn
2338	19-42623	See EURAEC-1363
2352	19-42821	See EURAEC-1377
2356	19-42803	See EURAEC-1397
2358	19-42846	See EURAEC-1399
2360	19-42822	See EURAEC-1401
2365	19-42627	See EURAEC-1406
EURAEC–		
1252	19-42820	Dep. nn; CFSTI, $1.00 cy, $0.50 mn
1363	19-42623	Dep. nn; CFSTI $1.00 cy, $0.50 mn
1377	19-42821	Dep. nn; CFSTI $2.00 cy, $0.50 mn
1397	19-42803	Dep. nn; CFSTI $2.00 cy, $0.75 mn
1399	19-42846	Dep. nn; CFSTI, $3.00 cy, $0.75 mn
1401	19-42822	Dep. nn; CFSTI $1.00 cy, $0.50 mn
1406	19-42627	Dep. nn; CFSTI $1.00 cy, $0.50 mn
1418	19-42804	See GEAP-3771-16
1425	19-43501	See BMI-X-10133
FZK–	**(Non-AEC)**	
243	19-42902	
GA–	**(Misc.)**	
6272	19-43353	Phys. Rev., 140: B50-62(1965)
6441	19-43405	
GA-Mech.–	**(Non-AEC)**	
62-2	19-42837	See AD-610234
GAT–		
505	19-42656	Dep. nn; CFSTI $1.00 cy, $0.50 mn
GAT-T–		
1215	19-42441	Nucl. Appl., 1: 375-80(1965)
1224	19-42412	Dep. nn; CFSTI $1.00 cy, $0.50 mn
GEAP–	**(Misc.)**	
3771-16	19-42804	Dep. nn; CFSTI, $3.00 cy, $0.75 mn
4775	19-42903	Dep. nn; CFSTI $4.00 cy, $1.25 mn
GEMP–	**(Misc.)**	
360	19-43269	Dep. nn; CFSTI $2.00 cy, $0.50 mn
HASL–		
163	19-42638	Dep. nn; CFSTI $2.50 cy, $0.75 mn
HW–		
77029	19-43586	Dep. nn; CFSTI $4.00 cy, $0.75 mn
83235	19-42455	Dep. nn; CFSTI $1.00 cy, $0.50 mn
HW-SA–		
3997	19-42237	Transplantation, 3: 610-17(1965)
IA–	**(Non-AEC)**	
1007	19-43270	Dep. nn
IAE–	**(Non-AEC)**	
587	19-43406	Dep. nn
844	19-43518	Dep. nn
855	19-43407	Dep. nn
863	19-43468	Dep. nn
864	19-43469	Dep. nn
IC–	**(Misc.)**	
65/64	19-43041	Dep. nn
65/70	19-43042	Dep. nn
IDO–		
14653	19-43623	Dep. nn; CFSTI $2.00 cy, $0.50 mn
IHP–	**(Polish)**	
406/C	19-42406	Dep.
IPP–	**(Non-AEC)**	
2/40	19-42904	Dep. nn
IPPJ–	**(Japanese)**	
33	19-43408	Dep. nn
34	19-43409	Dep. nn
35	19-43410	Dep. nn
36	19-43411	Dep. nn
38	19-43412	Dep. nn
IS–		
1220	19-42494	J. Chem. Phys., 43: 2547-8(1965)
IS-T–		
17	19-43630	Dep. nn; CFSTI $3.00 cy, $0.75 mn
20	19-42456	Dep. nn; CFSTI $4.00 cy, $0.75 mn
21	19-43470	Dep. nn; CFSTI $5.00 cy, $1.00 mn
26	19-42413	Dep. nn; CFSTI $2.00 cy, $0.50 mn
ITP–	**(Non-AEC)**	
133	19-43035	See AD-448108
JEN–	**(Spanish)**	
144-DQ/I-45	19-42578	Dep. nn
146-DQ/I-47	19-42414	Dep. nn
147-DQ/I-48	19-42415	Dep. nn
JINR–	**(Russian)**	
E-2293	19-43123	Phys. Letters, 18: 195-6(1965)
P-2160	19-42679	Dep. nn
P-2198	19-43271	Dep. nn
P-2202	19-43043	Dep. nn
P-2218	19-43272	Dep. nn
P-2223	19-42710	Dep. nn

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P-2238	19-43273	Dep. mn
P-2255	19-43044	Dep. mn
P-2256	19-42925	Dep. mn
P-2258	19-43045	Dep. mn
P-2262	19-42711	Dep. mn
P-2266	19-42961	Dep. mn
P-2274	19-42680	Dep. mn
P-2276	19-42712	Dep. mn
P-2279	19-43274	Dep. mn
JPRS-	**(Non-AEC)**	
31473	19-43640	CFSTI $5.00 cy, $1.00 mn
K-OA-		
1360	19-42794	Dep. mn; CFSTI $6.00 cy, $1.25 mn
KFK-	**(German)**	
304	19-43251	Dep. mn
LA-		
3253(Rev.)	19-43413	Dep. mn; CFSTI $4.00 cy, $0.75 mn
3314	19-42416	Dep. mn; CFSTI $1.00 cy, $0.50 mn
3315	19-43275	Dep. mn; CFSTI $2.00 cy, $0.50 mn
3334	19-43414	Dep. mn; CFSTI $1.00 cy, $0.50 mn
3349	19-43252	Dep. mn; CFSTI $1.00 cy, $0.50 mn
3355	19-42798	Dep. mn; CFSTI $2.00 cy, $0.50 mn
3365	19-42258	Dep. mn; CFSTI $3.00 cy, $0.75 mn
LA-DC-		
6529	19-42847	Dep. mn; CFSTI $1.00 cy, $0.50 mn
6565	19-42848	Dep. mn; CFSTI $1.00 cy, $0.50 mn
6995	19-43631	Dep. mn; CFSTI $1.00 cy, $0.50 mn
7019	19-42946	Phys. Rev., 140: A129-30(1965)
7135	19-43632	Dep. mn; CFSTI $2.00 cy, $0.50 mn
7157	19-43129	Phys. Rev., 140: B9-19(1965)
7247	19-42972	Rev. Sci. Instr., 36: 1401-8(1965)
LADC-		
6414	19-43589	Advan. Cryog. Eng., 10: 402-7(1965)
LNF-	**(Italian)**	
65/9	19-42681	Dep. mn
MATT-		
337	19-43446	Phys. Fluids, 8: 1748-50(1965)
347	19-43415	Dep. mn; CFSTI $1.00 cy, $0.50 mn
355	19-43445	Phys. Fluids, 8: 1745-7(1965)
MIT-	**(Misc.)**	
2098-147	19-43146	Phys. Rev., 140: B199-200(1965)
MLM-		
1256	19-42417	Dep. mn; CFSTI $1.00 cy, $0.50 mn
1262	19-42849	Dep. mn; CFSTI $1.00 cy, $0.50 mn
MRI-	**(Non-AEC)**	
158.21	19-42823	
N-	**(Misc.)**	
64-32021	19-42790	CFSTI $3.00 cy, $0.75 mn
64-32726	19-43030	See PIC-SOL-209/5.1(Vol.II)
NAA-SR-		
10621	19-42805	Dep. mn; CFSTI $2.00 cy, $0.50 mn
11134	19-42905	Dep. mn; CFSTI $3.00 cy, $0.75 mn
11150	19-43471	Dep. mn; CFSTI $3.00 cy, $0.75 mn
NAA-SR-Memo-		
11456	19-43276	Dep. mn; CFSTI $1.00 cy, $0.50 mn
NASA-CR-	**(Misc.)**	
281	19-43217	CFSTI $2.00 cy, $0.50 mn
54162	19-42790	See N64-32021
59014	19-43030	See PIC-SOL-209/5.1(Vol.II)
NASA-SP-	**(Misc.)**	
3018	19-42926	CFSTI $1.00 cy, $1.00 mn
7011(11)	19-42231	CFSTI $1.00 cy, $1.00 mn
NASA-TN-	**(Misc.)**	
D-2798	19-43218	CFSTI $5.00 cy, $1.00 mn
D-2798, pp 89-142	19-43226	J. Geophys. Res., 69: 3531-70(1964)
D-2917	19-42713	CFSTI $1.00 cy, $0.50 mn
D-2919	19-42770	Dep. mn; CFSTI $1.00 cy, $0.50 mn
D-2934	19-43231	CFSTI $2.00 cy, $0.50 mn
D-2973	19-43029	CFSTI $1.00 cy, $0.50 mn
D-2989	19-42850	CFSTI $1.00 cy, $0.50 mn
NEIC-RR-	**(Polish)**	
8	19-42973	Dep.
10	19-42974	Dep.
14	19-42777	Dep. mn
NEVIS-	**(Misc.)**	
138	19-43040	See CU-1932-244
NIJS-R-	**(Yugoslavian)**	
448	19-42418	Dep. mn
450	19-42595	Dep. mn
451	19-42419	Dep. mn
453	19-42457	Dep. mn
NIRL-R-	**(British)**	
84	19-42962	Dep. mn; BIS $1.20; HMSO 6s.
97	19-42963	Dep. mn; BIS $0.80; HMSO 4s.
98	19-43046	Dep. mn; BIS $0.80; HMSO 4s.
NLCO-		
955	19-42806	Dep. mn; CFSTI $3.00 cy, $0.75 mn
NP-	**(AEC File No. for Non-AEC Reports)**	
14922	19-42657	Dep. mn
15130	19-42596	Dep. mn
15162	19-42458	Dep. mn
15208	19-43277	Dep. mn Univ. Bruxelles, Inst. Phys., Bull., No. 20, 1-19(1965)
15219	19-43416	Dep. mn
15278	19-42639	Dep. mn
15281	19-42927	Dep. mn
15286	19-43047	Dep. mn
15288	19-43417	
15290	19-42928	
15311(Vol.I) (Pt.B)	19-42597	
15311(Vol.II) (Pt.B)	19-42598	
15312	19-42599	
15321	19-42906	Dep. mn; BIS Free
15326	19-42640	Dep. mn
15328	19-42658	
15333	19-42630	
15342	19-42600	Dep. mn
15345	19-42349	Dep. mn
15346	19-42350	Dep. mn
15347	19-42351	Dep. mn
15354	19-43633	
15357	19-43418	Dep. mn
15358	19-43278	Dep. mn
15366	19-42423	Dep. mn
15377	19-43048	Dep. mn
15383	19-43279	Dep. mn
15385	19-43461	Dep. mn
15392	19-43049	Dep. mn
15395	19-43050	Dep. mn
NUMEC-		
3432-12	19-42907	Dep. mn; CFSTI $2.00 cy, $0.50 mn
NYO-		
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